THE

Practical Teacher

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'*Knowledge is proud that he has learned so much,*
Wisdom is humble that he knows no more.'—COWPER.

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Health at School.

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IX.—DORMITORIES.

IT is now necessary to make a few suggestions upon the subject of Dormitories. It is one which is closely related to that of warming and ventilation, and cannot be left out of our work without making a gap in it. Health at School is intimately associated with bed-room accommodation in those schools which lodge the pupils, and which are usually called boarding-schools. This chapter will, of course, be applicable only to this class, and scarcely form part of the instruction to elementary schools. To the former class, a consideration of the sleeping accommodation, which is or ought to be provided, is the most important part of school hygiene.

There are different plans of arrangements in different classes of schools. In one kind the study and the dormitory are combined; this is a bad arrangement, and should not be tolerated. There is something more to be considered in this part of our work than pure air and simple sleeping accommodation. The morals of a school are closely connected with the character of the bedroom arrangements, and nothing tends so much to debase a bad boy's mind as the knowledge of the fact that he cannot be quietly supervised when at his work: that the master cannot see him without the boy himself knowing of the supervision. The knowledge is not injurious to the good boy, but the bad boy is sure to take advantage of it, and it will encourage the formation of habits which are never thrown off again if once indulged in. Study in the day-time should not be permitted in the bed-room. It has a tendency to make the air impure in spite of ventilation, and it allows of customs which will be indulged in, in the night as well as in the day-time. It leads the student to work at night, to keep awake when he ought to be asleep, and thus to alter the law of nature. The bedroom is for rest and sleeping, not for recreation or study. This is a rule which must not be departed from for if children get into the habit of reading in bed, or when they ought to be in bed, it is certain to interfere with their proper rest, and deprive them of some of that repair which the nervous system requires, and which is best obtained when the sun is below the horizon.

The next objectionable plan, at any rate for little children, is that in which the dormitory is divided into a number of compartments, which are sometimes called kennels, more usually cubicles. These have also the disadvantage of not being capable of easy supervision. It is the best kind of arrangement for young men and young women if the partitions are simple, not complete, and if they are used for the purpose of privacy, but not sufficient to impede ventilation; but boys and girls under fourteen do not want privacy, and cubicles are not advisable until puberty is approaching. The partitions should only be about five feet high, or not more than half the entire height of the room, and should not touch the floor of the room except at points for support; there should be a few inches of space between the partitions and the floor. They should be capable of removal for cleansing purposes, and in the holidays should be taken down and washed if they are wooden, whilst if they are canvas or linen, they should be properly disinfected by washing or heating and exposure to the open air for a few days before being put back again.

The number of kennels in any given room should never exceed from ten to twenty—twelve is a good number. They should occupy each side with a passage between the two rows of beds, and if possible there should be a window between each two beds. Care should be specially observed that the windows should open top and bottom. There should be at least half as many windows as there are beds in the room, and the windows should each be within a few inches of the ceiling. There should never be more than two rows of beds in any one dormitory. These arrangements apply whether there are cubicles or not. Large dormitories are not satisfactory. I know of some containing forty beds. There are serious objections to large rooms. If a case of infectious disease shews itself, it is usually in the morning when it is discovered, and all the children who have slept in the same dormitory are, or ought to be, necessarily put into quarantine, and the larger the dormitory the more difficult this is to accomplish. I prefer at the most from twelve to twenty beds. From a sanitary point of view, the open dormitory is better than the cubicle; for young children it is also morally better, so that

the teacher may be able to see the whole of the children at one glance, but as they grow up into young men and young women, they should be allowed privacy by means of cubicles. Evil habits are learnt most certainly in very early life, and vicious practices will not be so likely to be indulged in after fourteen if they have not been learnt before. No doubt the majority of children are opposed to vice, and it will not be openly indulged in in a dormitory. There ought to be a standing rule also, which the tutor should take care to have completely observed, viz., that no boy or girl should be allowed to go into another's cubicle on any kind of pretence; vicious habits will then be reduced to a minimum, and be restricted to a very small class, even in the largest schools. These habits very often have their origin in nerve irritation, and are a consequence of disease in the first instance, and if a boy is not allowed to impart his tendencies to others who are not diseased, the mischief is stopped in the bud, whilst if it is not checked in this manner, much harm may result from its propagation, and the morals of a given school be utterly ruined by one or two vicious or irritable boys. This cannot arise in a well-ordered school in which the dormitories are properly supervised, and the children not allowed to visit each other whilst in bed, or to frequent each other's cubicles. I urge this as a most important part of school management. If fairly carried out it may be the means of saving many a child from becoming an inmate of a lunatic asylum later in life.

The largest part of the pupils' time is spent in the bedroom; it is very necessary that the air should be kept pure, and that the room should not be overcrowded. School bedrooms should be at least twelve feet in height, and twenty feet wide, and six feet should be allowed for each bed. This would give about 700 cubic feet for each occupant of the dormitory, and this is only sufficient if the ventilation is good. The space allowed is often less than half this amount. In barracks the Government requires 600 cubic feet for each man. In lodging-houses it is sometimes fixed at 350. Children require nearly as much as grown-up people, but the character of ventilation provided is of more consequence than the cubical contents of the room. It is quite possible with good ventilation to do with 300 cubic feet per pupil for young children; without ventilation 700 feet will not be enough. If the height of a room is less than twelve feet, it is better to increase the distance between the beds on each side of the room rather than to make a wider room. It is to be borne in mind that a dormitory which is used as a sick ward, must not be occupied when so used by more than one-half the usual number of occupants, and it may be taken as an established fact that, in sickness, twice as much air is required as when the occupants are healthy. Each boy should have a separate chamber utensil. It is not satisfactory for children to be encouraged to use such things in common, and it is a bad arrangement when there is but one utensil for several children, and one common washing-place provided. Where possible each should, have a separate basin for washing purposes, and all the necessary appurtenances which belong to it in close proximity to it. It is not necessary for these to be by the side of the bed; indeed, for certain reasons it is better that they should not be so situated, but, each child should have access to cold water, and there should always be a plentiful supply at hand, which should be obtained from a pure source without difficulty. The chest which contains the child's clothing should be placed beside the bed, and upon it should be placed some cold water. If the dormitory is wide enough the wash-basins may occupy the centre of the room in a row. All being connected with one discharge pipe which should lose its contents in an open receiver situated on the outside of the house, and from thence be conducted to the sewer. The receiver should have a proper trap, and the pipe connecting it with the sewer would be safer if it discharged on to a grating, and did not communicate directly with the sewer; so that there should be a double impediment to the transit of sewer-air into the bedroom. The best kind of basins are those made of earthenware, which can be lifted up and empty themselves by swinging on an axis when they have been used, such as Jennings and other manufacturers make; they have introduced some excellent kind of basins, which are all managed on a good sanitary basis. The water supply for washing purposes should be plentiful and easy to be obtained. Each pupil should have his own basin and be responsible for its being emptied and washed down after use. Care should be specially observed that the towels, sponges, combs, and brushes belonging to each child should be capable of easy identification, and should be kept for separate use. Each chamber should have a monitor, who should be in charge of the washing-places, and who should see to the proper arrangement and cleanliness of towels, brushes, and combs. There should be a place in each room, especially for girls, for the reception of hair which may have been combed out of the head. This should not be put into the washing-basin, and must be kept out of the drain pipes, as it is a frequent source of stoppage when it is sent into the sewer. The use of grease for the hair should be strictly prohibited. Hair-oil and pomades have certain uses among dirty people, but they are out of place for children who are clean in their persons. In olden times, no doubt, grease on the hair prevented the growth of certain fungi which produced disease in the hair follicles. These fungi cannot grow in greasy matter, but it is far better to trust to washing and brushing, than to grease, for this purpose. If, however, brushes are not kept in order and are not restricted in their use to one person, it will be difficult to prevent infection when disease of hair does unfortunately find its way into a dormitory. Unkempt hair should be a breach of discipline, as much as a flaw in a given lesson. It is really important to observe these rules, for not only may ringworm and scald head be propagated by contact, but ophthalmia of an infectious character often invades schools, even among the higher classes, sometimes producing terrible mischief. In all such cases there has been default on points of cleanliness. It is important, therefore, that towels, brushes, and combs should be kept clean and be restricted to the use of one child only. Each child should have his own, and not be allowed to appropriate that of another boy. Immediately the children have left the bedroom the bedclothes should be thrown open, as well as the windows; and air freely admitted to the bed as well as to the bedroom. It is a serious mistake to have the beds made up as soon as the children have left the chamber. It is still more serious for the children to

be required to make their beds before leaving the room. If they have to make their own beds it should be done after morning study, and after the rooms and the bedding have been thoroughly ventilated. There should at all other times be a tidiness in the bedroom. The clothes which are taken off on going to bed should be placed in some kind of order, not thrown upon or under the bed, but folded up and placed ready for use in the morning. It is a mistake, however, to fold up the night dress immediately it has been taken off, neither should children be accustomed to sleep in their flannel underclothing. Those garments require to be ventilated as well as the night dress; it helps to deprive a child of the great benefit which arises from the use of flannel if it is slept in at night; there ought to be sufficient clothes on the bed for a child not to require it as a covering.

It is very important that there should be a free admission of fresh air during the night, and a continual escape of some of the used-up air. Ventilation must be as efficient in the bed-chamber as in the class-room, and it may be provided in those places which have a gas supply in a manner similar to that recommended for warming and ventilating a school-room. However well ventilated a bedroom may be, it should not prevent the opening of the windows immediately the children have dressed themselves, whatever may be the character of the outside air. If there is no gas supply, ventilation is efficiently promoted by a large fire-place in which the chimney has been left open, with Llouvre ventilators of large size above the door of the room. In summer-time the windows should be left open at night so as to admit fresh air from without. This requires an intelligent supervision, and must not be carried out by a hard and fast line. It is very unwise to allow children to sleep in air which is too cold; it is nearly as bad as allowing them to breathe the same air over and over again, or making them act as warming-pans for each other. It is very important that the bedroom should be kept clean, that the floor under the beds should be dusted, a damp cloth should be used for the purpose, and if it be kept damp by water containing a small amount of carbolic acid so much the better. The use of the carbolic water is not so much in destroying any possible infection, but in freshening up the air of the room and producing a rapid tendency to oxidation of any albumenoid matter which may happen to be present.

Besides the troubles caused to superintendents of large schools, by the vicious habits to which allusion has been made, there are others arising from a class of children who are very often harshly treated both at home and at school. I mean those children who are subject to a condition of things which leads them to wet their beds. This is a disease, and not a fault; no amount of punishment can possibly do more than make it worse. It arises from spinal irritation of a particular character, and must be met by special treatment under medical supervision.

In large schools it is best to have a dormitory for the special use of such boys with bedding arranged for the purpose, properly protected, better warmed than an ordinary dormitory, and ventilated a great deal more than is usual in the ordinary sleeping-room. The children should be made to get up about an hour after retiring to rest, and to use the chamber utensil. If they have any difficulty on this point, it may be overcome by putting the hands into cold water. They should be made to lie on their sides and not on the back, and when found lying on their backs they should be turned over on to their side again. Then shortly before 12 o'clock they should be roused and the utensil again used. It will be found that the larger portion of the incontinence of urine takes place before 12 o'clock at night. It will also be found that they are heavy sleepers, and that there is great difficulty in rousing them, and that they are asleep again the moment they lie down in bed. Indeed, after a time they do not recollect that they have been roused at all. It is a cruel thing to punish a child for this misfortune. A room occupied by children so troubled requires to be frequently visited and each sleeper examined. It may be cured by proper arrangements.

I should scarcely leave the subject of sleeping accommodation without a word upon the requirements of nature for sleep. Young children from four to seven require to spend at least half their time in bed. A child of seven should have twelve hours. The length of time to be spent in bed after that age may be gradually diminished, so that at fourteen nine hours is sufficient, at sixteen eight hours. It is important for health that this amount of sleep should be secured to children. The younger pupils should retire to rest first. It is a mistake to make children get up before daylight for the purposes of study. If the nervous system is properly refreshed, more work will be done in a given time than when the work is begun before daybreak and by the aid of artificial light. The standard which is reached in schools where the children work by artificial light in the morning, will not be found so high as in those in which this kind of morning light is more seldom required. It is a custom in some schools to keep the gas alight all night for the purpose of supervision; it as a bad plan. Darkness promotes sleep, and a well managed school in which muscular exercise is properly regulated, should have no difficulty on the score of wakefulness among healthy children.

Anecdotal Natural History.

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No. X.—THE SEAL TRIBE.

LIKE the whales, which formed the subject of the preceding paper of this series, the Seals are inhabitants of the water, although they are not entirely aquatic in their habits, as we shall presently see.

Supposing that we possessed no previous information upon the subject, a single glance at their outward structure would be sufficient to indicate to us the mode of life for which these animals were intended; for the long, slender body, and the broad-webbed limbs, formed almost like the fins of a fish, would at once inform us that the water was their appointed habitation.

For an aquatic life the seals are singularly adapted. The form of the body allows them to pass through the water with great facility, and the swimming powers

are so highly developed, that the animals are enabled to pursue and capture the fish in their own element.

If the motions of a captive seal are watched, as the animal disports itself in its tank, it will appear to pass through the water without active exertion, the lithe, supple body going through its manifold evolutions without any visible means of propulsion. By looking a little more closely into the matter, however, we may find out the secret.

The fore-limbs have but little to do with the matter, being used as an aid to progression more upon dry land than in the water. Indeed, when the seal swims, it presses the fore-feet, or flippers, as they are called, against the body. The hinder feet, however, which are not rudimentary as in the whales, but are flat and broad, serve both to propel the body through the water, and also as a rudder to direct its course. And this is managed in a manner very different to what we might expect. The feet do not beat the water, like those of the duck or swan or frog, and thus answer the purpose of oars, but are placed side by side, thus forming a single paddle, set edgewise, like the tail of a fish. These united feet being then swept from side to side, the animal is driven along by the action against the water, a slight alteration only of their position being required in order to direct the course.

By the aid of this simple means of progression, the seal is enabled to traverse the water with wonderful speed, and at the same time with an easy and undulating grace which is equalled by no other creature. This peculiar motion is owing in a great measure to the flexibility of the spine, which allows the body to be bent with facility in almost any direction.

Once upon dry land, however, the graceful movements degenerate into an ungainly shuffle, and the animal reminds the observer of some huge and overgrown caterpillar crawling awkwardly along. The fore-limbs now come into play, and the animal scuttles along, clumsily enough, it is true, but yet with considerable speed.

The nostrils and ears are provided with the means of preventing the ingress of water when the animal dives below the surface, the former closing by their own elasticity, while the latter are furnished with a structure analogous to that found in the whales. There is a curious point concerning the locality of the external ears. The orifice is not placed as we might think, directly over the organ itself, but below, and rather behind the eyes—a passage running beneath the skin to the ear itself.

The whiskers of the seal bear a very strong resemblance to those of the various animals of the cat tribe, their bases being connected with sensitive nerves which warn the animal of the slightest touch. It is thought that these may be of service in the pursuit of prey.

In order to protect the animal from the evil results of continued immersion, the body is clothed in a manner which effectually retains the vital heat. This is done in a threefold manner.

Beneath the skin is found a thick layer of fat, answering the same purpose as the blubber in the whales, and which of itself would, in water of ordinary temperature, be sufficient to retain the animal warmth. Inhabiting, however, as does the seal, the icy waters surrounding the polar regions, something more is necessary. This we find in a double coating of fur, the inner layer—the sealskin of commerce—being of a very fine and silky nature, and the outer of a more coarse and bristly nature, serving as a kind of thatch to the whole. When the animal is in the water this fur is pressed closely against the skin, and, being constantly lubricated with an oily fluid secreted by the skin, is rendered perfectly water-tight, just as is the proverbial 'duck's back.' This coating of fat also serves another and very remarkable purpose.

During the breeding season the adult males come ashore, and each takes possession of a piece of ground, and occupies it together with a number of females. Each male wants to enlarge his territory so as to accommodate more wives, but those who occupy the adjoining spots will fight to the death rather than allow him to encroach on their property.

No male seal, therefore, can leave his ground for a moment, as, if he did so, the surrounding proprietors would at once take possession of it, and carry off his wives. Therefore, he cannot venture into the sea for food; and, if he had not some other mode of sustaining life, would soon die of hunger. But, just as the camel can sustain life by absorbing the fat contained in its hump, so the seal can feed—if we may use the term—on the thick coating of fat which envelops the body.

An adult male seal is really a formidable antagonist. When in best condition, he will weigh some twenty-five stone, and by the mere rush of its onset, and weight of its body, will overset any human foe who does not know how to oppose it.

Strong though the seal may be, it has one part of its body which is as vulnerable as the heel of Achilles. It has been already mentioned that a great number of nerves converge upon the upper lips and nostrils. A blow upon the nose will instantly stun, even if it should not kill, the most powerful seal that ever lived. But it must be well aimed, as the fatal area is very small; and if it be missed, the antagonist will find himself sprawling on the ground, and in very evil condition from the mere weight of the seal as it flounders over him.

My readers may remember the celebrated fight between Hector McIntyre and the 'Phoca,' in Sir W. Scott's 'Antiquary,' and the discomfiture of the too impetuous Highlander.

The food of the seal consists chiefly of fish, which its wonderful powers of swimming enable it to capture with little difficulty. Various molluscs and crustacea, however, also form part of its diet.

In order to assist the animal in seizing its prey, and also in retaining it when once secured, the teeth are formed in a very singular manner. The sharp canines are long and powerful, and the molars are covered with sharp projections of various sizes, so that even the most slippery fish, when once fairly seized, has very little chance of escape. The tongue, for some unexplained reason, is slightly cleft at the tip.

The young of the seal are very few in number, seldom being more than two, and generally only one at a birth. When newly born they are almost white, the colour gradually deepening as they advance in age.

For the first few weeks of their lives the young seals are brought up upon dry land, the mother carefully tending them until they are sufficiently strong to take to an aquatic life.

All the seals are inhabitants of the colder seas, and are especially numerous on the borders of the Polar

Circle. The severity of the climate matters but little to them, for they are rendered secure from cold by their three-fold protection, and can always obtain prey beneath the ice, no matter what may be the season of the year.

In order to prevent the surface of the water from being completely frozen over, and thus separating them from the outside air, a number of seals are accustomed to congregate together into a single spot, thus keeping open a passage by the warmth of their bodies.

These passages are often utilized by the mother for the reception of her young, in the following manner:—

Ascending to the surface of the ice, the seal scrapes away the snow above the entrance to the passage, until she has excavated a small dome-like chamber, much wider than the passage itself. It will be seen that a ledge or shelf of ice must necessarily be left surrounding the aperture. Upon this shelf the baby seal is placed, and is there nurtured in safety by its parent until it is able to shift for itself.

Upon our northern shores, the Common Seal (*Phoca vitulina*) may mostly be seen, and on many parts of the Scottish coast is found in considerable abundance.

Seal-shooting is on these shores a sport which is quite as exciting as deer-stalking, and needs as much of the huntsman's craft. The seal is not only one of the most wary of animals, but it never shows more than its head above the surface of the water, and therefore affords a much smaller mark than a stag. Moreover, even when the sportsman has succeeded in hitting a seal, it often sinks as soon as hit, and he loses it.

Such a misfortune as a seal lost from sinking never occurs to the old hunter, and is a sure proof of inexperience. When a seal comes to the surface after a long dive it remains quiet for a time. A young hunter cannot resist so good a mark, sends a bullet through the animal's brain, and when he reaches the spot finds that it has sunk beyond his reach.

The reason is simple enough.

Like the whale tribes, the seals are enabled to remain for a considerable time under water in consequence of the power of aerating more blood than is required at the time.

Before diving the seal takes a number of long breaths, in order to aerate the blood fully, and just as it dives fills the lungs with a powerful inspiration. As it traverses its course below the water it allows the air to escape gradually, and its course can be easily traced by watching for the bubbles as they ascend to the surface.

Consequently, when the seal rises its lungs are empty, and if it be shot before it has had time to fill them it is sure to sink.

But if the hunter will have patience to wait until the animal has taken in its supply of air, and then shoot it, he will find that the air in the lungs will act like a float, and keep the body at the surface.

THERE are many different species of seals, several of which are named after animals which they are supposed to resemble. One of these is the Leopard Seal (*Leptonyx Weddellii*), or Sea Leopard, as it is indifferently termed, which derives its popular title from the whitish spots which are irregularly sprinkled over the body. This is not one of the larger seals, seldom exceeding ten feet in length, and not often attaining even to those dimensions. It is an inhabitant of various parts of the southern hemisphere.

A MORE interesting and well-known species is the Crested Seal (*Stemmatopus cristatus*), which is found upon the northern shores of America.

Upon looking at a specimen of this animal, the attention is at once struck by the remarkable crest, from which it takes its name. This strange structure springs from the muzzle, and rises to a height of several inches, supporting a kind of cowl which entirely covers the head. This curious organ, which is found in the adult male animal alone, is found to be a development of the 'septum,' or dividing gristle of the nose. As regards its object we are entirely at fault, the theory that it is intended to aid in the sense of smell at once falling to the ground when we consider that it is possessed by the adult males alone, being found only in a rudimentary form in the female and the young of both sexes.

Although the object of this strange development has not as yet been discovered, it is certainly of service to the animal as a means of protection when attacked by man. All the seals being particularly sensitive in the region of the nostrils, it is the usual practice of the hunters to stun them by a heavy blow upon the head, returning to complete the operation when the chase is over. The head of the crested seal is, however, guarded in a great measure by the curious helmet, and a blow sufficient to kill any ordinary seal serves only to stun the animal for a very short time.

When once roused, the crested seal is an active and formidable enemy, using both teeth and claws with considerable activity and address. Its strength, too, is very great, and as the animal averages some eleven or twelve feet in length, it will be seen that it is by no means a despicable foe.

The colour of the fur is a dark bluish black, paling almost to white beneath the body, and sprinkled with a number of greyish patches, each of which encloses a black spot. The head, tail, and feet are black. The fur is of considerable value in commerce, the skins being imported in great numbers.

NEXT comes the Harp Seal, or Atak (*Phoca Grœnlandica*), a closely allied species.

This animal derives its somewhat peculiar name from the markings of the body, which are disposed in a very singular manner. The ground colour of the fur is a whitish grey, upon which are drawn two broad bars of a jetty black running from the shoulders, where they almost join one another, to the root of the tail. The form of these markings has been supposed to resemble an ancient harp, thence its popular title. The greater part of the head is also black.

This peculiar marking does not show itself until the fifth year of the animal's existence, the fur until then changing its colour and markings with every successive season.

The harp seal is an inhabitant of the coast of Greenland and Iceland, where it is found in great profusion, and is much sought after on account of the valuable oil which is obtained from the bodies. Some idea of the extraordinary abundance of these animals may be gleaned from the statement, made a short time since by one of the leading daily newspapers, that one vessel alone, in the course of a single voyage, had procured no less than fifty thousand carcases, valued at more than thirty thousand pounds. In the season

1857, it is also said that half a million of seals were captured by the combined efforts of the vessels engaged in the trade. Success so great, however, is the exception, and not the rule, an ordinary season producing barely half the number of carcases.

Like the common seal, the harp seal is easily domesticated, being often tamed and taught to perform a variety of tricks. Both animals are remarkably docile and intelligent in disposition.

WE now come to the huge and ungainly monster known by the various titles of Walrus, Morse, and Sea Horse, and scientifically as *Trichecus Rosmarus*.

This is, perhaps, one of the most extraordinary of all the mammals inhabiting the water, its huge size, its bristle-fringed jaws, and the enormous projecting canine teeth, often nearly two feet in length, causing it to assume a strangely grotesque appearance.

Head of Walrus.

In consequence of the size of these tusks, the jaw is much enlarged in front, the protuberant muzzle giving to the animal a very ferocious aspect. The nostrils, for the same reason, are placed very high in the head. The lower jaw narrows rapidly towards the point, in order to pass between the two canine teeth.

The walrus is found in great quantities upon the borders of the Polar regions, both northern and southern, generally congregating in herds of some six or seven thousand in number. It is an animal of some value, even to civilised mankind, the oil and skin being in considerable request, while the tusks furnish valuable ivory, which has the advantage of retaining its colour for a very long period.

To less civilised nations, too, the walrus is almost a necessity of life; nearly all the soft parts of its body serve as food, while the intestines provide material for the construction of fishing nets, and hooks and other articles being made from the tusks. The sinews serve as fishing lines, and the skin as a covering for the 'kajak,' or boat, so that from the animal are procured the whole of the paraphernalia for obtaining fish. The oil is burnt in the lamps, without which life would be an impossibility, and, in fact, the walrus is to these people what the camel is to the Arab, or the bison to the North-American Indian, a necessary adjunct to existence.

Only a short time before these lines were written, an entire tribe of Esquimaux has perished because the walrus has deserted their coasts.

Skull of Walrus.

So needful do these tribes consider the walrus, that it is almost impossible to persuade them that life in any form is possible without the animals. They even carry the idea to a further pitch, and refuse to believe in the possibility of a future state of existence unless plenty of walrus are to be procurable. In vain the missionaries tried every means in their power to convince them into a belief in the Christian religion. 'No walrus, no heaven,' was the terse and conclusive answer, and there the matter had to rest.

Man is not the only being who recognises the merits of the walrus, for the Polar bear is fully aware of the advantages accruing to the fortunate slayer of the animal. He attacks it in a singular but very effectual manner.

Creeping closely up to the unconscious monster as it lies sleeping upon the shore, he leaps suddenly upon its back, clings to it with his hind feet and one of his fore feet, and delivers a series of tremendous blows upon its head with his unoccupied paw. Usually, this plan succeeds in a very short time, the mighty strokes first stunning the walrus, and at last smashing the skull.

Now and then, however, with an old and exceptionally thick-headed animal, the tables are reversed, the walrus plunging into the sea and carrying its opponent beneath the surface, where, in a few moments, he is obliged to relinquish his hold in order to obtain a supply of air, while his hoped-for prey makes good its escape.

The chase of the walrus, formerly a very easy matter before the animals had profited by bitter experience, is now a business requiring great caution and address.

The great difficulty is to prevent the animals from reaching the water, for which they at once make

when alarmed, passing over the ground at a wonderfully rapid pace. As nothing can stand against the combined onset of the alarmed animals, dogs are employed in order to separate them as much as possible, and to distract their attention from their pursuers. When driven to bay the walrus becomes a very formidable enemy, the huge tusks being capable of inflicting most terrible wounds.

In spite of its enormous size, a full-grown walrus attaining to the length of fourteen or fifteen feet, and weighing as much as a large elephant, the animal has often been tamed, and has even been taught to procure fish for its master, and to bring them to land untouched.

ANOTHER strange and grotesque animal of this tribe is the Sea Elephant, or Elephant Seal (*Morunga proboscidea*), so called from its enormous bulk, and also from the elongation of the snout, which somewhat resembles the trunk of the elephant.

Huge as is the walrus, the elephant seal is far superior in size, having been known to reach the extraordinary dimensions of thirty feet in length, and eighteen feet in the circumference of the body. This strange development, like the helmet of the crested seal, is found only in the adult males. Unless the animal is frightened or alarmed it is not very conspicuous; in such a case, however, the snout is thrown forward, and the animal blows through it with great violence, causing a strange harsh sound, which is audible at a considerable distance.

Notwithstanding their huge dimensions, the elephant seals are by no means so formidable as the walrus, apparently possessing no idea of revenging themselves upon their pursuers. When alarmed, they make for the water, the whole body quivering like so much jelly, on account of the fat with which the body is laden.

From this fat a valuable oil is procured in large quantities, a single animal yielding from seventy to eighty gallons; the skins, also, are of very fine quality.

The elephant seal is an inhabitant of the seas of the southern hemisphere, chiefly between 35 degs. and 55 degs. of south latitude. It is a migratory animal, travelling southwards as summer comes on, and northwards again at the approach of winter.

THE last of the seal tribe which we can mention in this paper is the Sea Lion (*Otaria jubata*), an inhabitant of Kamtschatka and the Kurile Islands, and also of Northern America.

The dimensions of this animal are about equal to those of the walrus, fifteen feet being an average length. Upon the neck and shoulders is a thick mass of stiff bristles, somewhat resembling the mane of a lion; to this is owing the popular name of the animal.

Sea Elephants.

The disposition of the sea lion is very quiet and peaceable, the animal falling an easy prey to the hunters. The animal is remarkable for the hoarse roar which it continually utters when on land, the united clamour of a herd of these creatures being almost deafening to the human ear. Amongst the animals related to its own species, however, it is very fierce and determined, ruling supreme in its own dominions, and holding the smaller animals in complete thraldom.

It seems strange that so mild and apathetic an animal upon shore should be so tyrannous in the water. Yet such is the case, and the sea lion may fairly be considered, even the crested seal not excepted, as the most fierce and savage of all the seal tribe.

(To be continued.)

Practical Lessons on Insect Life.

BY THEODORE WOOD, M.E.S.,

Joint Author of 'The Field Naturalist's Handbook.'

No. VIII.—THE ORTHOPTERA.

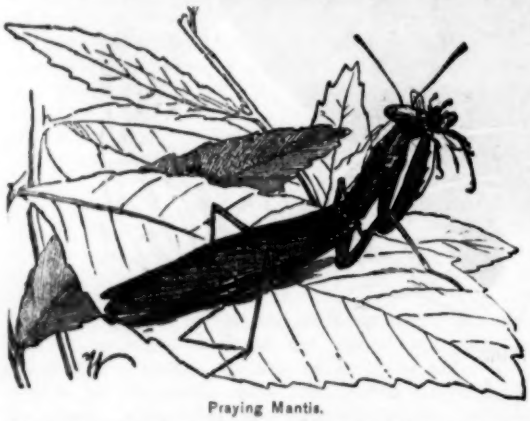
PART II.

THE strange insects bearing the popular title of Mantis are not represented in this country, although in many parts of the world they are plentiful enough. These insects constitute the second group of the *Orthoptera*, and are scientifically known as the *Raptoria*, or Snatchers.

This name they derive from the singular structure of the fore-legs, which are the weapons used in the capture of the prey.

The *coxa*, usually a comparatively insignificant joint, as far as size is concerned, is in these limbs developed to a considerable degree, almost equalling the thigh in dimensions. The thigh is strong, broad, and flat, with a deep groove running along it, this groove being furnished on either side with a number of sharp teeth. The *tibia* is also armed with spikes, and closes into the groove found in the *femur*.

When the mantis is in search of prey, and catches sight of an insect within a convenient distance, it creeps warily up, holding the fore-legs raised above the head, as shown in the illustration. When within striking distance, a rapid stroke is made, the insect is enclosed between the fore-legs, and, the tibiæ being drawn into



Praying Mantis.

the groove provided for them, the prey has no chance of escape.

This peculiar attitude of the fore-limbs was formerly thought to be that of prayer, and the insect was termed the Praying Mantis accordingly.

These insects are still regarded with superstitious feelings in many parts of the world. In some countries, for instance, it is thought that any one losing his way in the forest, and inquiring of the first mantis he sees, will be instantly directed by the insect, which is supposed to point out with the fore-limbs the necessary direction.

Most of these insects resemble in colour the foliage of the trees which they frequent, some species even changing their hues in accordance with the tints of the leaves at different periods of the year. It may thus be imagined, when the protective colours and the peculiar form are taken into account, that the insects are by no means easily to be detected.

Passing by the next group, namely, the *Ambulatoria*, which comprises the various Leaf and Walking-stick insects, none of which inhabit Great Britain, we come to the fourth and last division of the *Orthoptera*, viz., the *Saltatoria*.

As their name implies, the insects of this group, which includes the grasshoppers, locusts, etc., possess the faculty of leaping from the ground, sometimes to a considerable height.

As is the case with all leaping insects, the power lies in the hinder limbs, the thighs of which are long, and of very great comparative size.

The first family of this division comprises the *Achetidæ*, or Crickets, with the commoner species of which almost every one is more or less acquainted. These insects may be recognised by the size of the antennæ, which are generally almost equal in length to the body, and by the structure of the wings, which, when folded, are not entirely concealed by the elytra, but project for some distance beyond them. The males are furnished with two long antenna-like bristles at the end of the body, which appear to warn the insect of any danger approaching from behind; in the female the place of these organs is taken by the ovipositor, which is usually of considerable length.

The shrill noise uttered by the male insect is produced by the vibration of the elytra against one another, a rather curious modification of those organs giving rise to the sound. In each wing-case, a stout nervure starts from a thickened spot, some little distance from the base; in the right elytron the under side of this nervure is regularly notched, as though it had been grooved with a file.

When the insect is at rest, and the wings closed, the right elytron lies above the left in such a manner that the notched nervure rests upon the corresponding one in the left wing-case. The elytra are then put into rapid motion, and the grooved nervure rasps upon its fellow, with the result of causing the shrill sound with which we are so familiar.

The elytra differ to a considerable extent in the two sexes, and in some species form almost the only means of distinguishing between them.

The most abundant of our native species is, of course, the common House Cricket (*Acheta domestica*), which needs little or no description.

One peculiarity, however, lies in the structure of the ovipositor. This organ is very long and slender, and is terminated by a broad and sharpened tip, looking somewhat like the head of a spear. This apparatus is double, each of the parts being hollow, with a deep groove running along the entire length, thus forming a tube through which the egg can pass.

The spoon-shaped termination is also double, or rather quadruple, each of the parts being cleft along the centre, and opening and closing at the will of the insect. By this means the egg can be placed in a narrow aperture, being held, meanwhile, by elastic springs, which can be relaxed or contracted as necessity requires.

Another of our British species is the Field Cricket (*Acheta campestris*), which, although plentiful enough in many parts of the country, is, owing to its cautious and retired habits, far more often heard than seen.

This insect is not gregarious, each specimen living in a separate burrow, which it seldom leaves, except at night.

Being very wary creatures, retreating into their

tunnels at the mere sound of a footstep, they are not easily obtained. Strategy, however, will often succeed where open attack fails. For this cricket is easily roused to anger, and if a grass stem, or other similar object, be poked down the burrow, is sure to seize the intruder with its powerful jaws; a sharp jerk will then usually draw the insect from its retreat before it is able to relinquish its hold.

Like the domestic cricket, this insect is of a very quarrelsome nature, and if a number of specimens are placed together, a battle is sure to ensue, the combatants attacking one another with such fury that limbs are often torn from their bodies, and the weaker insects usually pay the penalty of their rashness with their lives.

Amongst the foreign crickets must be mentioned the extraordinary species known as *Acheta monstrosa*, which is remarkable for the structure of the claws, and also for the great length of the antennæ, each of which is composed of the wonderful number of two hundred and forty joints. The burrows sunk by this insect sometimes attain three feet in depth.

Closely allied to the preceding insects, although placed in a different genus, is the curious Mole Cricket, Croaker, or Chur Worm, as it is often called (*Gryllotalpa vulgaris*).

Mole Cricket.

This insect well deserves its popular title, bearing a strange resemblance, both in form and habits, to the animal from which it derives its name.

The fore-legs are constructed expressly for the purpose of burrowing through the earth, the *tibiæ* being broad, flat, and powerful, and armed with long and sharp claws, and the form of the limb almost exactly corresponding with that of the digging leg of the mole.

Digging Leg of Mole Cricket.

The *tarsus*, or foot, is small, and of little use during the operation of tunnelling, being packed out of harm's way beneath the broad *tibia*. This curious apparatus is well represented in the accompanying illustration.

In this insect the female is not provided with an ovipositor; the only method of distinguishing the sexes by outward examination lying in the structure of the elytra, as mentioned above, the notched nervure being present in the male alone. It is a curious fact that in the male the right elytron overlaps the left, while in the female the reverse is the case.

The colour of the insect is a rich reddish-brown, becoming considerably darker upon the thorax, and paling almost to yellow beneath the body. The elytra are also paler, with dark nervures.

The mole cricket is generally to be found in sandy soils, where it tunnels to considerable distances beneath the surface. A separate chamber is always constructed for the reception of the ova, and is situated near the surface of the ground, in order that the heat of the sun may penetrate to the cavity, while the eggs are protected from foes. The entrance to this cell is always at some little distance, a tunnel connecting it with the outer world.

Although this insect resembles the mole in so many points, it differs from that animal in one important particular, viz., the benefits it confers upon mankind. The mole, as has already been explained in these pages, is of the greatest service to agriculturists, its numberless tunnels answering the purpose of a most complete system of subsoil drainage, the earth brought to the surface serving to renew the soil, while the food of the animal consists chiefly of the grubs of those insects which find their food in the roots of the various crops, and whose destruction is therefore a matter of the greatest importance.

The mole cricket, however, affords us none of these benefits. Its tunnels are too few and slight to be of any value as far as drainage is concerned, and instead of preying upon the insects which damage the crops, it joins forces with them, feeding chiefly upon the roots of various vegetables. When the insects are plentiful, they have sometimes been known to cause considerable damage to garden plants of different kinds.

Their diet, however, is not always of a vegetable nature, for they have often been known to feed upon raw meat. Occasionally, also, they evince cannibalistic propensities, and attack their weaker brethren, the conqueror invariably devouring his vanquished foe.

We now come to another family, namely, that of the *Gryllidæ*, or Grasshoppers, our first example of which is the Great Green Grasshopper (*Acrida viridissima*), which is a tolerably abundant insect in most parts of the country.

The colour of this species is the most vivid green, which, however—as is almost invariably the case with insects of that hue—fades almost immediately after death, and becomes a dingy yellow-brown. Owing to the similarity of colour between the insect and the leaves of the trees which it inhabits, it is comparatively seldom seen, in spite of its abundance, even a practised eye often passing it by without detection.

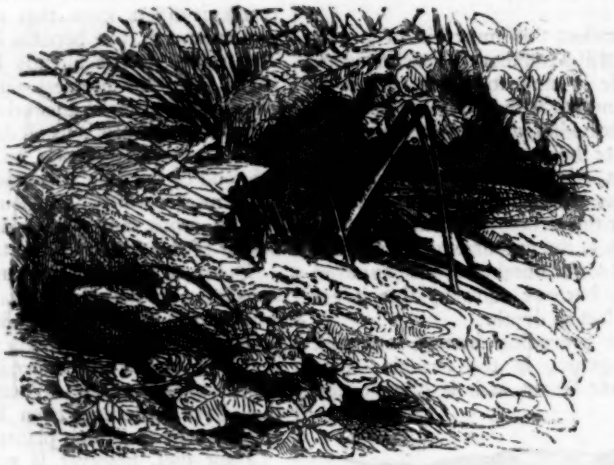
The sound emitted by this insect is very loud and shrill, and can be heard at a considerable distance. It is a curious fact that, to some, this sound, powerful as it is, is perfectly inaudible, the note being too shrill for the auditory nerves to transmit to the brain. A friend of my own is included among this category of individuals, although, strangely enough, he can detect the cry of the bat, which is of an even higher pitch, with the greatest ease.

The young of this grasshopper bear a strong resemblance to gigantic aphides, furnished with leaping limbs. They differ from the perfect insect in the absence of wings, and, in the females, of the ovipositor, which does not make its appearance for seven or eight weeks from the time of the commencement of the larval existence.

In the perfect insect this organ is formed in a somewhat singular manner, consisting of a number of blades, which can be separated in order to allow the egg to pass between them.

Another species is the Tree Grasshopper (*Meconema varia*), which is generally to be found upon the oak. This species has the peculiarity of being perfectly silent.

We now come to the well-known Locusts, which, happily for us, are extremely rare in this country. However, a few specimens almost annually find their way to our shores, and many more are chronicled, almost any large insect doing duty as one of these creatures. Even such totally dissimilar insects as the Death's-head and Humming-bird Hawk-moths have more than once been mistaken for the genuine locust. Most of the true locusts which are found in this country belong to the same species, *i.e.*, the Migratory Locust (*Pachytylus migratorius*), a representation of which accompanies this article. The colour of the insect is a pale brown, the elytra being marked with darker spots; the wings, which are broad and powerful, have a slight greenish tinge.



Great Green Grasshopper.

The destructive nature of the locust is only too well known, and there is little need to enlarge upon it in these pages. I may, however, be permitted to quote a passage from Lady Brassey's well-known work, 'A Voyage in the *Sunbeam*,' with reference to their numbers.

'In the course of our ride, we saw in the distant sky what looked very much like a heavy, purple thunder-cloud, but which the experienced pronounced to be a swarm of locusts. It seemed impossible; but, as we proceeded, they met us, first singly, and then in gradually increasing numbers, until each step became positively painful, owing to the smart blows we received from them on our heads, faces, and hands. As the locusts passed between us and the sun, they completely obscured the light; a little later, with the sun's rays shining directly on their wings, they looked like a golden cloud, such as one sometimes sees in the transformation scene of a pantomime; and, at a greater distance, when viewed from the top of a slight eminence, they looked like a snow storm, or a field of snow-white marguerites which had suddenly taken to themselves wings. When on the ground with their wings closed, they formed a close mass of little brown specks, completely hiding the ground and crops, both grass and grain. In riding over them, though not a quarter of their number could rise, for want of space in which to spread their wings, they formed such a dense cloud that we could see nothing else, and the horses strongly objected to face them.'

Migratory Locust.

The same author also states that railway trains are sometimes stopped by these creatures, not so much from their numbers, as that, on account of the oil flowing from their crushed bodies upon the line, the wheels will not hold the rails.

Only a year or two ago, also, during the Russo-Turkish war, the advance of a large army was stopped by a vast flight of locusts, which rendered progression utterly impossible until, after the lapse of a considerable time, their numbers had somewhat diminished.

Some idea of their multitudes may be formed from the fact, related by a modern traveller, that, after a severe storm, the locusts were heaped up into a vast bank three or four feet in height, and fifty miles in length.

It seems strange that insects furnished with such broad and powerful wings as are the locusts, should yet possess so little power of directing their flight. Yet such is the case, and the insects are unable to withstand the force of even a gentle breeze, being carried about by the wind and forced to travel in the direction in which it is blowing, always seeming to keep their heads to the wind and to drift backwards. For this reason great numbers perish by being blown out to sea, their dead bodies, when washed up by the tide, often forming a high wall many miles in length. They are also peculiarly susceptible to the effects of cold, and perish in multitudes

should there be any great falling off in the temperature.

Although to civilised man the locust must be regarded as an unmitigated pest, it is not so to him when in a state of nature. Many savage tribes, indeed, consider a flight of these insects in the light of a blessing rather than a curse. They have no crops, and therefore nothing to lose by the ravages of the insects. On the contrary, they gain by their advent, collecting the insects in vast quantities, and using them as food.

The mode of capture is simple in the extreme. Large fires are lighted, and fed with damp wood; this, of course, causes a thick smoke to ascend. The locusts, powerful insects as they are, have but little power of directing or altering their flight, and fall to the ground in myriads, stupefied by the smoke, when they are collected without difficulty.

By these people, the bodies of the locusts, when cooked, are considered as positive dainties, and the approach of a swarm is hailed with the greatest delight. Travellers, however, differ greatly in their accounts respecting this strange diet, some saying that it is almost nauseous, while others hold a diametrically opposite opinion. In one book we read that the flavour of the insects can only be compared to a mixture of linseed cake and burnt feathers, while another tells us that locusts form an admirable substitute for shrimps, from which creatures the sense of taste is unable to distinguish them. *De gustibus non est disputandum.*

Many other species of locusts are found in different parts of the world, none of them, however, causing such terrible havoc as that which has been above described, and which may fairly rank as the most destructive insect upon the face of the earth.

(To be continued.)

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'How I Teach Elementary Science.'

FOURTH SCHEDULE SUBJECTS: MECHANICS.

BY RICHARD BALCHIN.

IN last month's issue the reader will find a syllabus of one year's course of lessons in the second stage 'Mechanics.' I will now reproduce, as far as I am able to remember, a few lessons actually given before a division of V. and VI. Standard boys. I must here, however, remark, that at times the lesson may not appear to follow on in logical sequence, the break being caused by a thoughtful remark from one of the boys. It is never my plan to dismiss such a remark, but rather to work upon it. A boy is often discouraged to think, by the teacher's want of consideration for some question that the boy has put—a question which is often the outcome of a good deal of thought on part of the boy. I sometimes see, in the eyes and countenance of a child, that ideas are revolving in his mind, leading him to conclude that what I am saying does not exactly fit in with what he thinks; so he puts a question, which I may perhaps find a little inconvenient. Still it is, I think, better to step aside—of course within certain limits—and put the boy right. But so doing, I not only fix *his* attention for the remainder of the lesson, but probably awaken interest in other little minds that have been similarly exercised. What I feel I must do is this—to get, as it were, into the child's mind myself; to note all the avenues by which ideas enter; to see how they enter, and how they fix themselves there; how they associate with other ideas already there, and so by general union generate mental force; just as the union of atoms in the material world generates heat force.

The following lesson is the first on 'Matter in motion':—

Do you remember, boys, our lesson upon matter? Ans.—Yes, sir. Well, tell me something that we decided was not matter? Ans.—Sound. Now, something that *is* matter? Ans.—Wood. What term did we use for any very small division of matter? Ans.—Particle. Are there any particles in this room? Ans.—Yes, sir. Where? Ans.—On the ground; on our clothes; in the air. Can you see any particles in the air? Ans.—Yes, sir; in that sunshine. Are they in any other part of the air besides in that sunshine? Ans.—Yes, sir. How do you know that? you can't see them. Ans.—But when the sun shines in the other windows we can see them just the same. Very good. Now look again at the particles in those rays of light; what do you notice about them? Ans.—They are all moving about; all going from one place to another. Yes, and that boy has given such a good definition of motion that I will write it on the board:—'Motion is change of place.' Are the particles of dust on my coat, or the particles of chalk on that black-board, moving about? Ans.—No, sir. Yes, sir. Smith, you said 'no'; why did you say so? Ans.—Because they are not changing their place; they are quite still. Bayley, you said 'yes'; why did you say so? Ans.—Because *you* are moving about, sir; so the particles must be moving about too. Well, then, are there any particles in this room that are quite at rest—that do not move at all? Ans.—Yes, sir; on the ground; on the table; on the black-board. Bayley, do *you* think the particles on the ground are at rest or in motion? Ans.—(from Bayley) At rest. (Here several boys are getting excited, and half rising to ask questions.) But it was you, Bayley, who said the particles on my coat were moving because *I* was moving. Ans.—Yes, sir, I did; but the ground is not moving. (Here a boy jumped up, seemed all ablaze, and about to explode.) Please, sir, the ground *is* moving; all the world is moving. Well, Bayley, what do you say to that? Ans.—I know that the world is moving round the sun, but I was not thinking about *that* motion; I was thinking of the other. The other? What other? Are there, then, two kinds of motion? No answer? Now, boys, look at that sunshine again. You see the particles of matter, do you not? Ans.—Yes, sir. And you told me they were in motion; how do you know that? Ans.—Because we can see them in motion. Have those particles any motion that you or I cannot see? Ans.—Yes, sir. What motion is that? Ans.—Along with the air round the sun. Why can't we see that motion? Ans.—Because we are all going too. Just so. Suppose you wanted to tell a person of those two kinds of motion, how would you describe them? Ans.—I should say that one motion we can see, and the other we can't. (Another boy)—One motion is all about among themselves, and the other motion is altogether the same way. Very good; that boy is thinking. Now I will write on the board, words to describe those two kinds of motion. The first we will call 'Relative motion,' and the second 'Absolute motion.' When I was in the train on Saturday, I placed three books on the seat by my side, and they remained there until I took them up.

Were they at rest? Ans.—No, sir; not really, because they were moving with the train. Which of the two kinds of motion had they? Ans.—Absolute motion. (A boy)—Please, sir, they had relative motion as well. Indeed? Why do you think so? Ans.—They were moving with respect to the trees in the field. Yes, so they were. I am very pleased, Johnson, to find you are thinking. Now, is there any sense in which we could say the books were at rest? Ans.—Yes, sir; they were at rest among themselves. Well, now could you use one of those words on the board for that kind of rest? Ans.—Yes, sir. Which one? Ans.—Relative. Just so. We could say that they were at rest relatively but in motion absolutely. Can you tell me of anything that you consider at rest absolutely? Now think. Ans.—The air in this room. (Another boy)—The air is in motion, sir; our breathing puts it in motion. (Another boy)—Of course the air is in motion, for that makes the particles in the air move about. (Another boy)—Besides that, the air is moving with the earth round the sun. (Another boy)—There is not anything that is absolutely at rest. (Another boy)—Yes there is, sir; the fixed stars are. (Another boy)—Please, sir, it says in our reading book that all the fixed stars are really moving round some other star. (A boy)—Well, then, that other star that they all go round is at rest. Now, boys, the fact is, there is not a single object or atom of matter in the whole universe that, as far as we know, is absolutely at rest. This fact I will write down on the board. 'Motion is the law of the universe.' Take out your exercise books and write:—'Motion is change of place, rest is its opposite.' 'Relative motion happens when one thing changes its place with respect to some other thing.' 'Absolute motion happens when all are in similar motion together.' 'Relative rest happens when one object is at rest with respect to another.' There is no absolute rest. 'Motion is the law of the universe.'

Practical Organic Chemistry for 2nd B.Sc. Exam., London Univ.

BY H. CHAPMAN JONES,

Fellow of the Institute of Chemistry of Great Britain and Ireland; Fellow of the Chemical Societies of London and Berlin; Member of the Physical Society of London; Demonstrator of Practical Chemistry at the Royal School of Mines, and Professor of Organic Chemistry at the Birkbeck Institution.

[This article is supplementary to the Author's 'Text Book of Practical Organic Chemistry,' to which the references apply, and treats of those subjects required for the 2nd B.Sc. Exam. that are not contained therein. It is believed that the information necessary to secure a pass in that examination can be obtained, in a collected form, only from these sources].

ACIDS.

HYDROCYANIC ACID, HCN (HCy.)

The reactions of the simple cyanides are given at page 79. But it is necessary to observe that often two simple cyanides will combine and produce a compound which has properties quite distinct from those of either of its constituents. Such compounds are called *double cyanides*.

The need of special methods for the analysis of certain double cyanides will be rendered obvious by the consideration of an example. Ferrocyanide of potassium (K_4FeCy_6) is a double cyanide, which we may consider as produced by the combination of four molecules of KCy with one molecule of $FeCy_2$; but these molecules are so intimately connected together that the ordinary methods of analysis fail to demonstrate the presence of either KCy or iron in the compound.

Some double cyanides have therefore to be considered as salts of a single metal, the other metal being viewed as a constituent of a complex acid. Thus, analytically considered, ferrocyanide of potassium is the potassium salt of hydroferrocyanic acid (H_4FeCy_6), and not a compound of potassic and ferrous cyanides.

Some double cyanides are easily decomposed by dilute acids with evolution of HCy. Such need no special methods for their examination, although without a little care they may prove somewhat perplexing. For instance, the double cyanide of potassium and zinc ($2KCy,ZnCy_2$) is readily soluble in water. On adding dilute hydrochloric acid, the following reaction takes place:—

$$2KCy,ZnCy_2 + 2HCl = ZnCy_2 + 2KCl + 2HCy,$$

the $ZnCy_2$ being precipitated. Cyanides precipitated in this way may be readily dissolved by warming with more acid, or if needs be, pouring off the solution and warming with stronger HCl. There is then no further difficulty.

Hydrocyanic acid existing as simple cyanides may be detected in the presence of difficultly decomposable double cyanides, or sulphocyanates, by the reaction No. 3 at page 80.

The ferrocyanides and ferricyanides are the only difficultly decomposable double cyanides of common occurrence, and a study of the properties of these will enable one to deal with others if necessary.

HYDROFERROCYANIC ACID (H_4FeCy_6).

All ferrocyanides are decomposed on ignition; for example:—

$$K_4FeCy_6 = 4KCy + Fe + C_2 + N_2;$$

and on ignition with alkalies or alkaline earths, they give off their nitrogen as NH_3.

Ferrocyanides of the heavy metals are insoluble in water, and mostly insoluble in dilute acids; the alkaline salts are readily soluble in water to neutral solutions.

1. To K_4FeCy_6 add dilute HCl or H_2SO_4, and notice that no action takes place. On boiling HCy is evolved (see page 18).

2. To a small quantity of powdered K_4FeCy_6 in a test-tube, add strong H_2SO_4 and warm gently. Carbonic oxide is evolved, which may be ignited at the mouth of the tube (see page 21).

3. To a dilute solution of K_4FeCy_6 add Fe_2Cl_6. A precipitate of ferric ferrocyanide, or Prussian blue, is obtained.

$$2Fe_2Cl_6 + 3K_4FeCy_6 = Fe_4(FeCy_6)_3 + 12KCl.$$

This precipitate is unaffected by dilute acids, decomposed by alkalies as explained below, and soluble to a dark blue solution if the K_4FeCy_6 is kept in sufficient excess.

4. To a dilute solution of K_4FeCy_6 add $CuSO_4$. A chocolate brown precipitate of Cu_2FeCy_6 is produced, which is insoluble in dilute acids, and decomposed by alkalies.

5. To solution of K_4FeCy_6 add $FeSO_4$. A light-blue precipitate is obtained, which rapidly darkens on exposure to air. This precipitate is white if the ferrous salt is quite free from ferric, and oxidation is prevented. Its composition is, when pure $K_2Fe(FeCy_6)$.

6. To a solution of K_4FeCy_6 add $AgNO_3$. A white precipitate is obtained, Ag_4FeCy_6, which is insoluble in dilute HNO_3 or AmOH.

Oxidizing agents such as chlorine, convert all soluble and some insoluble ferrocyanides into ferricyanides, the iron being changed from the ferrous to the ferric condition thus :—

$$2K_4FeCy_6 + Cl_2 = K_6Fe_2Cy_{12} + 2KCl.$$

Hydroferricyanic Acid, $H_6Fe_2Cy_{12}$.

Ferricyanides are decomposed on ignition in a similar way to ferrocyanides. The alkaline ferricyanides are soluble in water, the others mostly insoluble. The following reactions are numbered to correspond with those of hydroferrocyanic acid.

1. Ferricyanides are not acted on by cold dilute acids.

2. When warmed with strong H_2SO_4, carbonic oxide is evolved.

3. To a dilute solution of $K_6Fe_2Cy_{12}$ add Fe_2Cl_6. No precipitate is produced, but the solution is turned brown. Add a drop of sulphurous acid or solution of $NaHSO_3$, a dark blue precipitate falls at once. It should be noticed that the reduction of either compound, causes a dark blue precipitate.

4. Cupric sulphate gives with $K_6Fe_2Cy_{12}$ a dirty greenish yellow precipitate.

5. To a solution of $K_6Fe_2Cy_{12}$ add $FeSO_4$. A dark blue precipitate of ferrous ferrocyanide or Turnbull's blue ($Fe_3Fe_2Cy_{12}$) is obtained.

6. To a solution of $K_6Fe_2Cy_{12}$ add $AgNO_3$. An orange-coloured precipitate of $Ag_6Fe_2Cy_{12}$ falls. It is insoluble in dilute HNO_3, soluble in AmOH.

The solubility of this precipitate in AmOH sometimes occasions a difficulty in looking for HCl. In such a case, it is best to slightly acidulate a part of the solution with HNO_3, then to add $ZnSO_4$ which will precipitate the $H_6Fe_2Cy_{12}$ (also H_4FeCy_6 and HCy), filter, and test the filtrate for HCl as usual. This method of separating the cyanogen acids will often be found convenient.

Potassic ferricyanide is very readily reduced in alkaline solutions to ferrocyanide, by almost anything that is capable of oxidation—including filter paper.

Insoluble Double Cyanides.

The presence of such a substance may generally be ascertained by collating the results of the examination in the dry way, the preliminary examination for acids, and the solubility of the mixture. If still doubtful, warm the substance with water, wash the insoluble residue well, add NaOH and heat to boiling, filter, and test the filtrate by acidifying it with HCl and adding Fe_2Cl_6, and if no blue colour is produced, a drop or two of SO_2 solution. If no blue colour is obtained, there are no insoluble ferro- or ferricyanides present.

If an insoluble double cyanide is present, the analysis of the substance should be carried out as follows :—

1. Examination in the dry way.
2. Preliminary examination for acids.
3. Make an aqueous extract of a suitable quantity of the substance, and examine this extract in the wet way for bases and acids as usual.
4. Wash well the residue that is insoluble in water, add NaOH to it, heat to boiling and filter. Examine a part of this extract for the bases of the Cu,As and Ni,Al groups (some of which metals are soluble in NaOH), and the other part for acids, *except HCl and* H_2SO_4 (chlorides and sulphates are invariably contained in caustic soda). To test for H_4FeCy_6 and $H_6Fe_2Cy_{12}$, acidify with HCl and add Fe_2Cl_6, and if necessary SO_2 (see reactions for these acids numbered 3 and 5).
5. The residue not soluble in soda must be washed very carefully, and dissolved in HCl, and examined as usual for bases, except alkalies, and for phosphoric acid, which it will be seen may be present as alkaline earthy (or Al or Cr) phosphate.

Uric Acid, $C_5H_4N_4O_3$.

Uric acid is practically insoluble in water (also alcohol and ether), but soluble in alkaline liquids. This should be confirmed by adding some water to the acid and warming, then alkali to dissolve it. Acids precipitate uric acid from its solutions.

Urate of ammonia is sparingly soluble in cold water, so that a solution of uric acid in hot ammonia deposits crystals on cooling.

Heat a small quantity of uric acid in a bulb tube. Notice that the acid does not melt nor swell up, and that the black residue is less in bulk than the acid taken. Also observe the crystalline sublimate, and that hydrocyanic acid is evolved during the heating.

1. Warm some uric acid with dilute HCl ; no change is perceptible.
2. Warm some cautiously with strong H_2SO_4, and notice that it gradually dissolves. At a certain temperature, a vigorous evolution of SO_2 takes place, and the liquid becomes of a dark red colour. On adding water it will be evident that complete solution has taken place, and that there has been no blackening. This reaction should be tried three or four times, and it will be found difficult to secure uniform results.
3. Moisten some dry uric acid with strong HNO_3 in a porcelain dish, and carefully dry it. A red residue is obtained, which is turned to a reddish purple by ammonia, or a blueish purple by potash. These colours are very intense, and the reaction altogether very characteristic.

Gallic Acid, $C_6H_2(OH)_3.CO.OH$.

Gallic acid dissolves readily in hot water or alcohol.

Heat a small quantity of the crystals in a bulb tube; it melts, gives off water, then blackens and evolves a red substance, which will be found as an ill-defined sublimate.

Heat a portion on platinum foil, and observe that it melts and gives off white fumes, then turns red, then black and burns with a luminous flame, and leaves a black residue, which may be burned by further heating.

1. Heat a small quantity of gallic acid with dilute HCl ; it dissolves, the acid having apparently no effect on it.
2. Heat a further quantity with strong H_2SO_4, and notice that the gallic acid dissolves, and that the liquid

gradually assumes a rich red colour from the formation of rufigallic acid. If a few drops of the solution are poured into water, the rufigallic acid separates on standing for a minute or two as a reddish-brown precipitate. On heating the strong H_2SO_4 solution to a higher temperature it readily blackens.

3. To an aqueous solution of gallic acid add Fe_2Cl_6. A blue-black precipitate or colouration is obtained. To part of the liquid add HCl; the colour disappears. Heat another part until it is decolourized. The gallic acid is oxidized by the iron salt, which is itself reduced. It follows, therefore, that cooling will not restore the colour, but that if the gallic acid is in excess, the addition of an oxidizing agent (sodic hypochlorite), or more Fe_2Cl_6, will give a further black colour.

4. Gallic acid gives no precipitate with gelatin, albumin, or starch paste.

5. To an aqueous sclution of gallic acid in a porcelain dish, add NaOH. The liquid rapidly turns reddish-brown, and deposits a black substance. AmOH produces the same effect, but more slowly. These changes do not take place if oxygen is excluded.

TANNIC ACID, $C_{14}H_{10}O_9$.

The above formula for tannic acid is that of two molecules of gallic acid minus one of water. Natural tannin is probably a glucoside of this body, so that the commercial article contains glucose, in quantities varying according to the extent of its purification. These differences, however, will be found to influence the following reactions, but slightly. The numbers are the same as those prefixed to the similar reactions of gallic acid.

Tannic acid is readily soluble in water, but not so soluble in solutions of salts, acids, etc. Hence the addition of acids to aqueous solutions of tannic acid may precipitate it, but it readily redissolves on adding more water or warming.

Heat a small quantity in a bulb tube, and notice that it behaves much like gallic acid, but swells up rather more, and probably gives off the odour of burning sugar.

Heated on platinum it fuses, blackens at once, and burns more readily than gallic acid, the difference being chiefly, if not altogether due to the presence of glucose.

1. Heat a small quantity of tannic acid with dilute HCl; no apparent change takes place.

2. Heat a portion of the solid with strong H_2SO_4; the solution becomes reddish, but speedily blackens. The smaller the quantity of glucose, the less rapid will this blackening be.

3. To an aqueous solution of tannic acid add Fe_2Cl_6. A black precipitate is obtained of a blueish or greenish tint. The colour disappears at once on the addition of HCl, and slowly fades on boiling, like the corresponding colour given by gallic acid.

If $FeSO_4$ is used instead of Fe_2Cl_6, the colour produced at first will be very faint, and darken gradually as the iron-salt gets oxidized. With this reagent gallic acid shows a little difference of colour, but it is not safe to rely on this difference as a method of distinguishing between tannic and gallic acids.

4. To a rather strong solution of tannic acid add a solution of gelatin * and shake. A yellowish-white precipitate forms at once. More dilute solutions should be treated in the same way, as the precipitate is not so easy to recognize when in small quantity. Starch paste and albumin give white precipitates with tannic acid.

5. Alkaline solutions of tannic acid resemble those of gallic acid in absorbing oxygen, and so gradually assuming a dark reddish-brown colour.

* Conveniently prepared by boiling a small piece of parchment (or fine shavings of glue or isinglass) with water for a few minutes.

NEUTRAL BODIES.

ALCOHOL, $\begin{matrix}CH_3\\|\\CH_2OH.\end{matrix}$

This is the only liquid substance mentioned in the Syllabus for the 2nd B.Sc. It may readily be distinguished from water, or detected in an aqueous solution, by its smell and inflammability.

If mixed with water, the liquid must be subjected to fractional distillation, care being taken to distil over only a few drops of the liquid at first, this portion being tested as to its inflammability and smell. A further quantity may then be distilled, and warmed with a rather dilute solution of potassic dichromate, acidulated with H_2SO_4. If the chromate is reduced, that is, changed from red to green, the presence of alcohol may be considered as proved. If the chromate solution is too strong, the change of colour will be incomplete, unless indeed the alcohol is present in a correspondingly large quantity.

STARCH, $(C_6H_{10}O_5)_n$.

Starch is an organized body, and its different varieties may be distinguished by means of the microscope. But chemically considered, all the starches have the same properties.

Shake up a small quantity of starch with some water. The starch does not dissolve, and if set aside, it will settle down, and may be completely recovered.

Take another part, and instead of allowing the starch to settle, warm it gradually until it gelatinizes and forms a mucilaginous liquid. This is called 'starch-paste'; the heat has burst the starch granules, and the substance of them is diffused through the water. It is not generally allowed that this is a true solution, although it may be diluted and filtered without separating the starch.

On ignition in a bulb-tube, starch blackens, and yields much water with acid fumes. Heated with free access of air, as on platinum foil, it appears to melt, then burns with a bright flame, and leaves a black residue, which may be burned away by further heating. An ash remains, but this is almost imperceptible when small quantities are used.

1. Heat some starch with dilute HCl to boiling, and observe that it gelatinizes much less than when heated with water. By the prolonged action of dilute acids it is entirely converted into soluble substances.

2. Warm starch with strong H_2SO_4. The liquid soon blackens, grows thick, and evolves a slight odour of burning sugar.

3. Prepare some starch-paste as described above, and allow it to cool. Add to it a solution of iodine (either in potassic iodide or in alcohol); a deep blue precipitate or solution is produced. Divide the liquid into several parts, and see that the colour disappears by the application of heat and returns on cooling, un-

less the iodine has been volatilized. The colour is not affected by dilute acids, but is destroyed by reagents that cause the iodine to enter into combination, as alkalies, sulphuretted hydrogen, etc.

GRAPE SUGAR (GLUCOSE), $C_6H_{12}O_6$.

Water dissolves nearly its own weight of grape sugar, to form a viscous liquid. Dilute solutions are comparatively limpid.

Heat a small quantity of grape sugar in a bulb tube. It melts readily, froths up, turns black, and evolves water and the odour of burning sugar. Heated on platinum foil it behaves in a similar way; the black residue may be burned by continued heating, and a white ash obtained if the sugar was no purer than is common.

1. Warmed with dilute acids, glucose undergoes no visible change.

2. Put a small quantity into strong H_2SO_4. So long as the acid is cold, it will fail to blacken even if allowed to act for hours; but on warming it speedily blackens, and grows thick with effervescence.

3. To a solution of grape sugar add NaOH and boil. The liquid turns to a reddish brown colour, and a humus-like substance is formed, which will deposit on standing.

4. To a solution of grape sugar add a few drops of $CuSO_4$, then excess of NaOH. In the presence of the sugar the copper is not precipitated, but forms a blue solution. Gently warm the mixture, and notice the precipitate, at first brownish yellow cuprous hydrate, afterwards bright red cuprous oxide.

UREA, $CO(NH_2)_2$.

This substance is best considered as a neutral body, for it gives no reactions with the general reagents for organic bases (see next section), although it combines with many acids to form salts of greater or less stability.

Urea dissolves with ease in either water or alcohol, but is nearly insoluble in ether. Cold water dissolves its own weight of urea.

Heat a small quantity of urea in a bulb tube, and notice carefully the very characteristic decomposition that ensues. It melts to a water-like liquid at 120°, then appears to boil, and gives off large quantities of ammonia, and forms a small sublimate. On continuing the application of heat, the residue grows less liquid, the sublimate greatly increases, and the odour of ammonia is exchanged for a short time for the sharp acid odour of cyanic acid, which is characterized by its effect on the eyes. There is no blackening, and the final residue is inappreciable.

1. On warming urea with dilute HCl there is no apparent change.

2. Heat a small quantity with strong H_2SO_4. It gradually dissolves, and at a temperature at which the acid begins to fume, a vigorous effervescence sets in, due to the escape of CO_2. The nitrogen remains as an ammonia salt, thus:—

$$CO(NH_2)_2 + H_2SO_4 + OH_2 = CO_2 + (NH_4)_2SO_4.$$

There is no blackening.

This conversion of urea into $CO_2 + 2NH_3$ by the assimilation of water, may also be brought about by boiling it with alkalies in aqueous solution. In this case the CO_2 remains with the alkali, and the ammonia is evolved; but this action is slow, even if the alkali is fairly concentrated; the detection of the ammonia, therefore, is not a very good reaction for the presence of urea.

3. To a rather strong aqueous solution of urea add about one fifth its bulk of strong HNO_3. A precipitate of crystalline laminæ or rhombic plates of nitrate of urea will speedily form. In a dilute solution, these crystals may take some hours to deposit, but they will be of more characteristic appearance. A concentrated solution of oxalic acid gives a similar reaction with urea.

4. To a solution of urea add an excess of sodic hypochlorite, and warm gently. A slow evolution of nitrogen takes place with effervescence, which is best observed by watching the liquid just after it has been withdrawn from the source of heat. A solution of nitrous acid in nitric acid gives a similar result.

BASES.

Of the large number of organic bases known, we have to consider only three, namely, Quinine, Morphine, and Strychnine. The following general remarks are only intended to be applied to these three, though in many cases they are equally applicable to the bases as a class.

These bodies are also called alkaloids, because in many of their reactions they behave like the alkali ammonia. It is most probable that they are derived from one or more molecules of ammonia, by replacing a part or all of the hydrogen by organic radicals.

GENERAL REACTIONS.

These reactions may be confirmed with either or all of the alkaloids available.

The alkaloids are sparingly soluble in water, but readily soluble in dilute acids, forming salts. Solutions of their salts are precipitated by alkalies.

Heated in a bulb-tube they readily blacken and give brown liquid distillates.

1. The alkaloids are precipitated by $PtCl_4$ from acid solutions as light yellow precipitates. Dilute solutions of morphine must be evaporated to get the reaction.

2. A solution of phospho-molybdic acid in nitric acid* precipitates the alkaloids from acid solutions as yellowish precipitates. The action of ammonia on these precipitates will be described under each individual alkaloid.

3. A solution of potassic iodide saturated with mercuric iodide gives yellowish-white, gelatinous or curdy precipitates with the alkaloids. Dilute acids do not prevent these reactions.

4. A solution of iodine in aqueous potassic iodide, gives with dilute acid solutions of the alkaloids, reddish-brown precipitates. These precipitates are decomposed by KOH, the morphine compound being soluble therein.

* This solution is prepared by dissolving in carbonate of soda solution the thoroughly washed precipitate obtained by adding sodic phosphate to the nitric acid solution of ammonic molybdate. The solution so obtained is evaporated to dryness, and ignited till no more ammonia is evolved, and the residue dissolved in water and nitric acid, taking care that the nitric acid is in large excess.

It should be observed that reactions 3 and 4 distinguish the salts of the alkaloids from salts of ammonia; that the second reaction does not distinguish them, except by the subsequent addition of ammonia; and that $PtCl_4$ also precipitates salts of ammonia, but the precipitate is far less easy to get, being more soluble, and is of a redder colour than the compounds formed by quinine and strychnine.

QUININE, $C_{20}H_{24}N_2O_2$.

1. Warm some sulphate of quinine with strong H_2SO_4. It dissolves, the solution gradually turns yellow, then blackens when the acid nearly boils. The solution does not thicken as it blackens.

2. To a solution of quinine (in dilute HCl) add NaOH. A white pulverulent precipitate of the free alkaloid is obtained, which is insoluble in excess of the reagent, but may be dissolved out by agitation with ether. AmOH gives a similar reaction.

3. To an acid solution of quinine add a few drops of sodic hypochlorite (or some good chlorine water), then AmOH in excess. A fine green colour is produced.

Repeat this experiment with a dilute solution of quinine, but before adding the AmOH, put in some solution of potassic (ferro- or) ferricyanide. The careful addition of the alkali will now produce a magnificent red colour, which changes in a few minutes to a reddish brown.

4. To a quinine solution add some phospho-molybdic acid solution; a yellow precipitate falls. Add now excess of AmOH; the yellow precipitate is changed to a much smaller white one.

MORPHINE, $C_{17}H_{19}NO_3$.

1. To a small quantity of morphine add strong H_2SO_4. If the acid is pure, there will be no colour produced in the cold, and on warming, a brown colour will be developed, which darkens as the heating is continued.

If the H_2SO_4 contains any nitric acid, the solution will develope a red colour on gently heating it. This colour is best obtained by first warming the morphine with strong H_2SO_4, then when nearly cold, adding a drop of HNO_3. So produced the colour is a rich red, inclining a little to purple, but soon passes into a lighter tint.

2. To a solution of a morphine salt add NaOH very carefully. A white crystalline precipitate is obtained readily soluble in excess of NaOH.

AmOH produces the same precipitate, difficultly soluble in excess, and Na_2CO_3 also precipitates the alkaloid insoluble in excess of the reagent. Morphine may therefore be precipitated from its solution in NaOH by acidifying, and then adding either AmOH carefully, or Na_2CO_3.

3. Put some solid morphine into a porcelain dish, and pour over it a few drops of Fe_2Cl_6. Triturate the morphine with a glass rod, and observe the blue colour produced. Divide this solution into two parts, and to one add HCl; the colour disappears at once. Warm the other; it gradually changes to a reddish brown; the blue colour returns on cooling it.

4. To an acid solution of morphine add the phospho-molybdic acid solution; a yellow precipitate falls. Add now AmOH; a deep blue solution is obtained. This reaction is highly sensitive and characteristic.

STRYCHNINE, $C_{22}H_{24}N_2O_2$.

1. Warm some strychnine with concentrated H_2SO_4. It dissolves without any change of colour, and blackens only very slightly even when the acid is heated to its boiling point.

2. To a solution of strychnine in HCl add NaOH; a white crystalline precipitate is obtained, which is insoluble in excess of the reagent.

If AmOH is used instead of NaOH, the precipitate dissolves readily in excess, but the solution soon begins to deposit the alkaloid in the form of silky needles.

3. Put a crystal of strychnine in a porcelain dish, add to it a drop or two of strong H_2SO_4. When solution has taken place, rub the liquid with a crystal of $K_2Cr_2O_7$, and a rich violet colour will be obtained, quickly passing through purple to red, then to reddish brown. Other oxidizing agents, such as peroxide of lead or ferricyanide of potassium, produce a similar play of colours. This reaction is very sensitive and characteristic.

4. To an acid solution of strychnine add the phospho-molybdic acid solution, and to the yellow precipitate obtained add excess of AmOH. The precipitate dissolves to a colourless liquid. In this reaction strychnine salts resemble ammonium salts.

—o—

Engagements for December.

December	1.	Linnean Society	8 p.m.
„	2.	Finance Committee of Orphanage, N.U.E.T.	7.30 p.m.
		Council of Orphanage, N.U.E.T.	8 p.m.
„	3.	Organisation Committee, N.U.E.T.	10 a.m.
		Meeting of Executive, N.U.E.T.	11 a.m.
„	5.	B.Sc. Exam. (Hon.) London University.	
„	7.	Geological Society	8 p.m.
		Parliamentary and Law Committee, N.U.E.T.	7.30 p.m.
„	8.	Royal Society	4.30 p.m.
„	9.	Finance of Prov. Society, N.U.E.T.	7 p.m.
		General Board, N.U.E.T.	8 p.m.
		New Shakspere Society	8 p.m.
„	12.	Finance and General Purposes Committee, N.U.E.T.	7.30 p.m.
		Education Society. 'Herbert Spencer's Educational Writings,' by Mrs. Bryant	7.30 p.m.
„	14.	Anthropological Institute	8 p.m.
„	15.	Linnean Society	8 p.m.
		York College Distribution of Prizes.	
		Royal Society	4.30 p.m.
„	16.	Meeting of Executive, N.U.E.T.	7 p.m.
		Finance Committee of Benev. N.U.E.T.	7 p.m.
		Browning Society, Paper by G. Barnett Smith, Esq.	8 p.m.
„	17.	Organisation Committee, N.U.E.T.	10 a.m.
„	19.	Central Committee of Benev. Fund, N.U.E.T.	7.15 p.m.
„	21.	Geological Society	8 p.m.
		Parliamentary and law Committee, N.U.E.T.	7.30. pm.
„	22.	Royal Society	4.30.p.m.

CHRISTMAS SONG.

Words by GEORGE BENNETT. *Music by* T. CRAMPTON.

Joyously. mf *cres.*

1st TREBLE.
2nd TREBLE.
BASS.

1. Spring-time is a time of beau-ty, Ju - bi-lant with joy and song; Sum-mer brings us
2. Win-ter's cold we are not fear-ing— Ice and snow to sport in-vite; No-thing warms us
3. We can make the Christ-mas mer-ry, And the new year hap-py, too, If at home and

KEY B♭. *Joyously. mf* *cres.*

1st TREBLE.
2nd TREBLE.
BASS.

f *p*

gold-en sun-shine, Hap-py days and ev-'nings long; But with win-ter's gloom the sea-son
up like skat-ing, Or like jol-ly slides de-light: We can keep the pot a-boil-ing,
school we're striv-ing What is right and best to do; This will height-en our en-joy-ments,

KEY F. *f* KEY B♭. *p*

mf

That we love is hast-'ning near, And its com-ing we are hail-ing In our dreams with shout and cheer.
Though no blaz-ing fire is near; Cheeks will glow and eyes will brighten At the thoughts of Christmas near.
When with kin-dred hearts we meet, And with fes-tive hopes and wish-es All the loved and lov-ing meet.

mf KEY F.

CHORUS.

When the sing-ers, waits, and ring-ers, Wake the glad-some song and chime, And the youth-ful, fond, and truth-ful,

KEY B♭. CHORUS. KEY F. KEY B♭.

f *p*

Wel-come give to Christ-mas-time.

Symph. for Harmonium.

We beg to announce that any of the songs which have appeared in the back numbers of the PRACTICAL TEACHER may now be obtained separately, price 6d. per dozen, post free.

Pupil Teacher's Examination Questions.

OCTOBER, 1881.

CANDIDATES.

Three hours and a half allowed.

Arithmetic.

MALES.

1. Find the difference between the cost of 3,592 articles at £3 12s. 8d. each, and 3,683 articles at £2 4s. 11d. each.
2. If an 18-gallon cask of beer lasts for 4 weeks and 4 days, how many pints of beer are consumed in 3 days?
3. A person bought 8 acres 1 rood 6 poles at £56 an acre, and 18 acres 2 roods 33 poles at £52 an acre, together with a farm-house worth a quarter of the price of the whole of the land. What amount of purchase money was required altogether?
4. I exchange 18 dozen of wine for a gold snuff-box weighing 8 oz. 13 dwts. 10 grs., valued at £4 10s. 0d. per oz.; at what do I value the wine per dozen?

FEMALES.

1. Make out the following bill:—
   81 lbs. of tea at 2s. 11d. per lb.
   99 lbs. of coffee at 1s. 7½d. per lb.
   54 lbs of cocoa at 1s. 5d. per lb.
   243 lbs. of rice at 2½d. per lb.
   31 lbs. 8 oz. of butter at 1s. 10d. per lb.
   63 lbs. of loaf sugar at 7½d. per lb.
   108 lbs. of moist sugar at 3½d. per lb.
   38 lbs. 4 oz. of bacon at 10d. per lb.
   55 lbs. 2 oz. of cheese at 8d. per lb.
2. Find the cost of 14,773 acres 2 roods of land at £63 10s. 6d. an acre.
3. What is the value of 1,491 articles at £32 11s. 1d. each?
4. 30 cwt. 3 qrs. 9 lbs. 12 oz. at £16 6s. 8d. per cwt.

Grammar.

1. Parse all the verbs in the following:—
   'The king looked long upon her:
   "I would thou wert not here;
   Yet I refuse thee nothing,
   Because thou art so dear."
   Up sprang that joyous lady
   And eagerly she bade
   That they should loose the fetters
   Upon those captives laid.'
2. In what classes may adjectives be arranged? Give examples in each class.
3. What is meant by 'case'? What are the cases of nouns in English, and how do you distinguish them?

Geography.

1. Describe a coasting voyage from Gravesend to Southampton.
   If you can, draw a map of this portion of the coast.
2. The subject for a prize theme at a school was:—
   '*Which is the finest river in Great Britain?*'
   Four boys tried for the prize; one born in London, one in Glasgow, one in Perth, one in Welshpool; and each chose his own river. What did each find to say? And which do you think ought to have got the prize?
3. Name six important towns in Ireland. Describe fully the situation of each, and mention any circumstances connected with them.

Composition.

Write from dictation the passage given out by the Inspector.

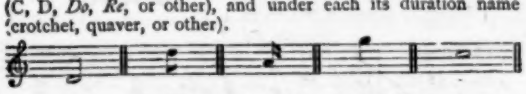
Penmanship.

Write, in large hand, as a specimen of copy-setting, the word *Witherslack*.

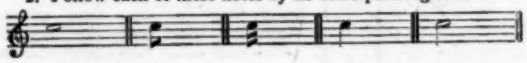
Write, in small hand, as a specimen of copy-setting, *There are fifteen English yachts at Trouville.*

Music.

1. Write, over each of the following notes, its pitch name (C, D, *Do*, *Re*, or other), and under each its duration name (crotchet, quaver, or other).



2. Follow each of these notes by its corresponding rest.



3. How many tones and semitones are found in a major scale, and what places therein do the latter occupy?

ANSWERS.—CANDIDATES.

Arithmetic.

MALES.

1. (*a*)

		£	s.	d.
Value at £1 ... ... =		3592	0	0
				3
„ £3 ... ... =		10,776	0	0
„ 10s. = ½ value at £1 =		1796	0	0
„ 2s. = ½ „ 10s. =		359	4	0
„ 8d. = ⅓ „ 2s. =		119	11	8
„ £3 12s. 8d. =		13,050	18	8

(*b*)

		£	s.	d.
Value at £1 ... ... =		3683	0	0
				2
„ £2 ... ... =		7366	0	0
„ 5s. = ¼ value at £1 =		920	15	0
		8286	15	0
less „ 1d. = 1/240 „ 5s. =		15	6	11
		8271	8	1

diff. of (*a*) and (*b*) = (£13,050 18s. 8d. − £8271 8s. 1d.) = £4779 10s. 7d. Ans.

2. 18 galls. or 144 pts. for 32 days = 4½ pts. for 1 day.
   ∴ they consume 4½ × 3 or 13½ pts. in 3 days.

3. (*a*)

		£	s.	d.
Value of 1 ac. ... ... =		56	0	0
				8
„ 8 ac. ... ... =		448	0	0
„ 1 rd. = ¼ value of 1 ac. =		14	0	0
„ 5 po. = ¼ „ 1 rd. =		1	15	0
„ 1 „ = ⅕ „ 5 po. =		0	7	0
„ 8 ac. 1 rd. 6 po. =		464	2	0

(*b*)

		£	s.	d.
Value of 1 ac. ... ... =		52	0	0
				18
„ 18 ac. ... ... =		936	0	0
„ 2 rds. = ½ val. of 1 ac. =		26	0	0
„ 20 po. = ¼ „ 2 rds. =		6	10	0
„ 10 „ = ½ „ 20 po. =		3	5	0
„ 2 „ = ⅕ „ 10 „ =		0	13	0
„ 1 „ = ½ „ 2 „ =		0	6	6
„ 18 ac. 2 rds. 33 po. =		972	14	6
Sum of (*a*) and (*b*) =		1436	16	6
and ¼ of „ „ =		359	4	1½
∴ the purchase money =		1796	0	7½ Ans.

4.

		£	s.	d.
Value of 1 oz. ... ... =		4	10	0
				8
„ 8 oz. ... ... =		36	0	0
„ 10 dwts. = ½ value of 1 oz. =		2	5	0
„ 3½ „ = ¼ „ 10 dwt. =		0	15	0
„ 2 grs. = 1/240 „ 3½ „ =		0	0	4½
„ 8 oz. 13 dwts. 10 grs. =		39	0	4½
∴ 18 doz. costs		39	0	4½
and 1 „ „		2	3	4½ Ans.

FEMALES.

			£	s.	d.	
1.	81 lbs. at 2s. 11d. per lb. ...	=	11	16	3	
	99 „ 1s. 7½d. „ ...	=	8	0	10½	
	54 „ 1s. 5d. „ ...	=	3	16	6	
	243 „ 0s. 2¾d. „ ...	=	2	15	8½	
	31½ „ 1s. 10d. „ ...	=	2	17	9	
	63 „ 0s. 7½d. „ ...	=	1	19	4½	
	108 „ 0s. 3½d. „ ...	=	1	11	6	
	38½ „ 0s. 10d. „ ...	=	1	11	10½	
	55½ „ 0s. 8d. „ ...	=	1	16	9	
			36	6	6¾	Ans.

			£	s.	d.	
2.	Value of land at £1 per ac. ...	=	14773	10	0	
					7	
			103414	10	0	
					9	
	„ £63 „	=	930730	10	0	
	„ 10s. = ½ at £1	=	7386	15	0	
	„ 6d. = 1/20 „ 10s.	=	369	6	9	
	„ £63 10s. 6d.	=	938486	11	9	Ans.

			£	s.	d.	
3.	Value of whole at £1	=	1491	0	0	
					4	
			5964	0	0	
					8	
	„ £32	=	47712	0	0	
	„ 10s. = ½ val. at £1	=	745	10	0	
	„ 1s. = 1/10 „ 10s.	=	74	11	0	
	„ 1d. = 1/12 „ 1s.	=	6	4	3	
	£32 11s. 1d.	=	48538	5	3	Ans.

			£	s.	d.	
4.	Value of 1 cwt.	=	16	6	8	
					6	
			98	0	0	
					5	
	„ 30 cwt.	=	490	0	0	
	„ 2 qrs. = ¼ value of 1 cwt.	=	8	3	4	
	„ 1 „ = ½ „ 2 qrs.	=	4	1	8	
	„ 7 lbs. = ¼ „ 1 „	=	1	0	5	
	„ 2 „ = 1/14 „ 1 „	=	0	5	10	
	„ 8 oz. = ¼ „ 2 lbs.	=	0	1	5½	
	„ 4 „ = ½ „ 8 oz.	=	0	0	8¾	
	„ 30 cwt. 3 qrs. 9 lbs. 12 oz.	=	503	13	5¼	Ans.

Grammar.

1. *looked*—intrans. reg. verb, indic., past indef., 3rd pers. sing., agreeing with subj. *king*.
would—defective verb (*will, would*), indic., past indef., 1st pers. sing., agreeing with subj. *I*.
wert—irreg. substantive verb *am, was, been*, subjunctive, past indef., 2nd pers. sing., agreeing with subj. *thou*.
refuse—reg. trans. verb, indic., pres. indef., 1st pers. sing., agreeing with subj. *I*.
art—irreg. subj. verb, *am, was, been*, indic., pres. indef., 2nd pers. sing., agreeing with subj. *thou*.
sprang—intrans. verb, strong con., *spring, sprang, sprung*, indic., past indef., 3rd pers. sing., agreeing with subj. *lady*.
bade—trans. verb, strong con., *bid, bade, bidden*, indic., past indef., 3rd pers. sing., agreeing with subj. *she*.
should—defect. auxiliary verb, *shall, should*, indic., past indef., forming with the infinitive of reg. verb,
loose—the past indef. potential, 3rd pers. plur. agreeing with subj. *they*.
laid—complete part. of *lay, laid, laid*, agreeing with *fetters*.

2. Adjectives may be arranged in *three* classes—
(1) Adjectives of *quality*, e.g., *good, old, red, beautiful*.
(2) „ *quantity*, e.g., *one, two, little, much*.
(3) „ *distinction*, e.g., *first, this, each, next, my*.

3. *Case* is an inflexion of nouns and pronouns for showing the relation which they bear to other words. The cases of nouns in English are (1) the *Nominative*, which is used to express the *subject* of a sentence, as *I* smiled, *He* sang.
(2) The *Possessive*, used to show the possessor of something, as, *John's* hat, the *boy's* cap; (3) the *Objective*, used when the noun or pronoun is acted upon by a verb, or when it is the object of a relation (governed by a preposition), as, He strikes the *door* with a *stick*; 'I know *him* of *whom* you speak.'

Note.—When a person is addressed, the noun is sometimes said to be in the Vocative case, as '*John*, come here,' and the noun or pronoun in such sentences as 'Give *him, them, John*, etc., some money' is also said to be in the *Dative* case. The Dative case (or indirect object) also occurs after such words as *like, next, near*, etc., as '*like* him,' 'next them.'

Geography.

1. Starting from *Gravesend*, a great summer resort, we come to *Sheerness*, a fort built after the insult of the Dutch, 1667, and then to the much-frequented watering-places *Margate* and *Ramsgate*. This part of Kent used to be separated from the mainland by the Stour, and was called the *Isle of Thanet*. Passing *Sandwich* we come to *Deal*, with its many boatmen and pilots, who depend for a living on the shipping which resort to the *Downs* lying between the shore and the *Goodwin Sands*. *Dover* is a busy port, having great passenger traffic with the Continent. On this coast were the original Cinque Ports established by the Conqueror, *Sandwich, Dover, Hythe, New Romney*, and *Hastings*. Sailing west we reach *Hastings*, near the famous battlefield of 1066; and *Brighton*, a beautiful town, and a favourite resort of George IV. Passing *Selsea Bill* we come to *Spithead*, the safest roadstead in England, and after visiting *Portsmouth*, with its famous dockyard and fortifications, we arrive at our destination *Southampton*, a very important packet station to the West Indies and the Mediterranean.

2. The *Thames*, rising in the Cotswold Hills, has a basin not consisting of only one valley but of many, all opening into the largest valley. The various secondary river-systems are separated from one another by intervening higher lands, penetrating far in the general level of the drainage. This system of valleys gives a beautiful diversity of hill and dale, that renders the Thames scenery very pleasing; and in the upper part of its basin the country is well suited for the production of grain and dairy produce. The Thames above London is noted for the purity of its waters, and its current is neither rapid nor sluggish. Though it may not excel some rivers in the beauties of Nature it is the chief river of Great Britain, has the largest city in the world on its banks, and is commercially by far the most important on the face of the globe. Few rivers can boast of such places as *Oxford, Eton, Windsor, Richmond, Chelsea, Greenwich, Woolwich, Chatham*, and *Sheerness*, which both enhance its natural attractions, and give the stream a classic character.

The *Clyde* rises in the Lowther Hills, and after its union with the Douglas forms a succession of beautiful cataracts, the chief being the magnificent falls of Cora Lin. It afterwards takes a north-west course through a comparatively well-cultivated district, and after receiving several tributaries, spreads out at Dumbarton into a broad estuary. Few rivers, it has been said, can boast of scenery of greater variety or of greater beauty than the Clyde. Above Glasgow, its course is now through verdant lawns, now through rocky defiles, and now between steep and gorgeously wooded banks. Below Glasgow, where it widens into an estuary, lofty hills rise on every side, and bound the far distance. Lochs or arms of the sea branch off at various points on the north and west, carrying the eye of the tourist into mountain valleys, while the shores are studded with beautiful villas and watering-places, the resort not only of Glasgow citizens but of visitors from all parts of Britain. The whole presents a panorama of unequalled beauty, grandeur, and magnificence, an attraction to painters and lovers of nature from all parts of the earth.

The *Tay*, rising in the Southern Grampians, flows in a north-easterly direction expanding into the beautiful Loch Tay. It is afterwards joined by the Tumel, which is acknowledged to be one of the finest of Scottish rivers. After receiving the Tumel, the Tay flows south, and the scenery is very picturesque, and continues so till two miles south of Dunkeld. It then traverses a well-cultivated and fertile country, and enters the German Ocean below Dundee, where it was crossed by an iron bridge, a wonderful structure, which came to grief in the storm of 1879. The Tay is fed by some very picturesque tributaries, and is known to be the finest salmon river in Great Britain. Its basin is bounded by the Grampians, Ochil, and Sidlaw Hills. Perth, an ancient city on its banks, has one of the finest situations of any town in Scotland, and the view from Kinnoul hill gives a picture of the valley of the Tay which is admired for its beauty.

The *Severn* rises on the east side of Plinlimmon, under the name of the Hafren, 'queen of rivers.' At Newton it receives the name of Severn, flows through the beautiful vale of Mont-

gomery, and continues on through a series of almost unrivalled vales, pursuing its romantic course through the counties of Salop, Worcester, and Gloucester. The nature of the Welsh country precludes the possibility of extensive plains, but gives the valleys generally a narrow rugged form, which is particularly favourable to romantic beauty. These valleys, respectively known as the vale of Worcester, the vale of Gloucester, and the vale of Berkeley, are not only distinguished for their great natural beauty but also for their fertility.

3. *Dublin* is the capital of Ireland on the Liffey. Its castle is the residence of the Lord-lieutenant. Besides being the seat of government, Dublin is the seat of the Irish law-courts, of a university, and of various learned and scientific bodies. The magnificence of its cathedral and public buildings entitle it to rank as one of the finest cities in Europe. Its jail, Kilmainham, has become famous under the Coercion Act.

Belfast lies on the north side of the Lagan at the head of Belfast Lough. It is next to Dublin in respect of population, and one of the most rapidly rising towns in the whole kingdom. Belfast is the centre of the Irish linen trade, as well as the chief seat of both the linen and cotton manufactures of Ireland. In an island on the Lagan is an iron ship-building yard, from which have been launched some of the finest vessels afloat. One of the Queen's colleges of Ireland is situated in Belfast.

Cork is the principal town in the south, on one of the safest and finest harbours in Europe. It possesses great trade in the export of grain and all sorts of provisions. It is the seat of one of the Queen's colleges. The port of Cork formerly known as the Cove, is now called Queenstown in honour of the Queen's visit in 1849.

Limerick stands at the head of the estuary of the Shannon, carries on important linen and other manufactures, and is the leading port on the west coast for the export of raw produce. Famous for its siege (1690-91).

Galway is at the mouth of the Corrib in Galway Bay, has also considerable trade in raw produce, and is the seat of one of the Queen's colleges.

Londonderry, the principal port on the north coast, stands at the head of L. Foyle. It sustained a memorable siege against the whole Irish forces of James II. (1688-89).

Music.

1.

2.

3. Five tones and two semitones, the latter being found between the 3rd and 4th, and 7th and 8th notes of the scale.

FIRST YEAR.

Pupil Teachers at end of First Year.

Three hours and a half allowed.

Arithmetic.

MALES.

1. Find the value of 112 oz. at £4$\frac{1}{12}$ per cwt.

2. If the poor rate paid on a house rated at £63 be £2·390625, what amount of poor rate ought to be paid in £ s. d. on a farm rated at £272?

3. Find by decimals and by vulgar fractions, the difference between $\frac{1}{8}$ and $\frac{3}{25}$ of half a crown, and reduce it to the decimal of half a guinea.

4. Compare the values of ·875 of 5s. 3d., and ·785 of 6s. 8d.; and state the difference.

5. One-third of a package of cloth is sold at 2s. 6d. a yard; one-fourth of it at 1s. 6d. a yard; the remaining 25 yards at 1s. 10d. a yard, gaining by the whole transaction 2d. a yard on the cost price. Find the whole gain.

FEMALES.

1. A bill for gas being £5 9s. 3d., when gas was at 4s. 9d. per 1000 ft.; what will it be when the price of gas is increased by 1s. 6d. per 1000 ft.?

2. If 6 men can reap 16 acres in 4 days, working 10 hours a day, in how many days will 10 men reap 24 acres, working 12 hours a day?

3. A number of men built a wall 50 yds. long in 20 days of 12 hours each, in how many days of 10 hours each could they have completed it?

4. If after paying income tax at 1s. 2d. in the pound, a gentleman has £701 10s. 10d. remaining, what is his annual income?

Grammar.

1. Parse all the pronouns in the following passage:—

'Once more my sire's abode
Is mine, behold the floor I trode
In tottering infancy!
And there the vaulted arch whose sound
Echoed my joyous shout and bound
In boyhood, and that rang around
To youth's unthinking glee.'

2. Pronouns admit of more inflexions than nouns. Prove by examples that this is so.

3. Prepositions are said to indicate relations of place, of time, of causality. Give examples of prepositions indicating each relation.

Geography.

Answer Q. 1, *or* Q. 3, *not both.*

1. The subject for a prize-theme at a school was:—*Which is the finest river in Europe?*

Four boys tried for the prize, one born at Seville, one at Lyons, one at Cologne, one at Buda-Pesth; and each chose his own river. What did each find to say? And which do you think ought to have got the prize?

2. Draw a full map of Italy.

3. Name six important towns in Ireland, and say what you know of each.

History.

1. Write down a list of our kings from Egbert to Ethelred, with dates.

2. Give the dates of William I., Henry II., Edward I., and Richard II., and name their immediate successors.

3. Write out a list of our sovereigns from 1625 to 1714, with dates.

Penmanship.

Write in large hand, as a specimen of copy-setting, the word, *Witherslack.*

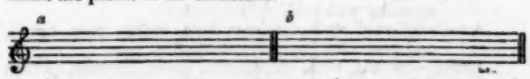
Write in small hand, as a specimen of copy-setting, *There are fifteen English yachts at Trouville.*

Composition.

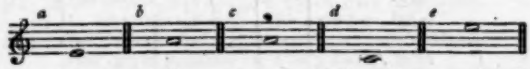
Write from memory the substance of the passage read to you by the Inspector.

Music.

1. Write in *a* the scale of A (*La*), and in *b* the scale of E♭ (*Me*), placing a sharp or a flat before each note requiring one. Mark the places of the semitones.



2. Place its second below *a*, its third below *b*, its fourth above *c*, its fifth above *d*, and its octave below *e*.



3. How many semiquavers are equal (in length) to one minim?
How many quavers are equal (in length) to one semibreve?
How many crotchets are equal (in length) to one dotted minim?

ANSWERS.—FIRST YEAR.

Arithmetic.

MALES.

1. 1 cwt. or 1792 oz. cost £4$\frac{1}{12}$ or 68d.
1 oz. ,, 68d. ÷ 1792
∴ 112 oz. ,, 68d. × $\frac{112}{1792}$
i.e. or 4$\frac{1}{4}$d. Ans.

2. £63 pay a rate of £2·390625 or £2 7s. 9$\frac{3}{8}$d.
£1 " £2 7s. 9$\frac{3}{8}$d. ÷ 63
∴ £272 " £2 7s. 9$\frac{3}{8}$d. × $\frac{272}{1}$
i.e. 9$\frac{3}{8}$d. × 272 = £10 6s. 5$\frac{1}{2}$d. Ans.

3. $\frac{1}{3}$ of 30d. = $\frac{1}{10}$ or ·1 of 30d.
$\frac{1}{15}$ " = $\frac{2}{30}$ " ·06 "
∴ the diff. = $\frac{1}{10}$ " ·1 of 30d., *i.e.* 3d. which is $\frac{1}{240}$ of 10s. 6d. or $\frac{1}{20}$, and this fraction reduced to a decimal = ·0238095. Ans.

4. (*a*) ·785 = $\frac{785}{1000}$ = $\frac{157}{200}$; and $\frac{157}{200}$ of 6s. 8d. = 5 2$\frac{2}{3}$
(*b*) ·875 = $\frac{875}{1000}$ = $\frac{7}{8}$; and $\frac{7}{8}$ of 5s. 3d. = 4 7$\frac{7}{8}$
∴ (*a*) is greater than (*b*) by 0 7$\frac{7}{24}$d.

5. $\frac{1}{3}$ + $\frac{1}{4}$ = $\frac{7}{12}$; ∴ 25 yds. = $\frac{1}{12}$ of the whole, and the whole = 25 × $\frac{12}{1}$ = 60 yds.
∴ A gain of 2d. per yd. gives 60 times 2d. or 10s.

5. If it mean that the 60 yds. were bought at 1s. 8d. per yd. then the whole gain = (20 yds. at 2s. 6d.) + (15 yds. at 1s. 6d.) + (25 yds. at 1s. 10d.) − (60 yds. at 1s. 8d.) = £5 18s. 4d. − £5 0s. 0d. = 18s. 4d.

FEMALES.

1. At 57d. per 1000 ft. the cost is £5 9s. 3d.
1d. " " 1311d. ÷ 57
∴ 75d. " " 1311d. × $\frac{75}{57}$
i.e. 23d. × 75 = £7 3s. 9d.

2. 10 men : 6 men
16 ac. : 24 ac. :: 4 days : days required.
12 ho. : 10 ho.
4 days × $\frac{6}{10}$ × $\frac{24}{16}$ × $\frac{12}{10}$ = 3 days.

3. Working 12 ho. a day they take 20 days
" 1 " " 20 days × 12
" 10 " " 20 days × $\frac{12}{10}$ or 24 days.

4. The sum of 18s. 10d. is got from £1
" 1d. " £1 ÷ 226
∴ £701 10s. 10d. or 16837od. " £1 × $\frac{16837}{226}$ or £745.

Grammar.

1. *My*—pronominal poss. adj. attributive to *sire*.
mine—personal pron. 1st pers. masc. sing. poss., attributive to *(abode.)*.
I—personal pron. 1st pers. masc., sing. nom., subj. of *trode*.
whose—simple relative pron. referring to *arch*. neut. sing., poss., attributive to *sound*.
my—*as before* attrib. to *shout*.
that—simple rel. pron., referring to *arch*, neut., sing., nom., subj. of *rang*.

2. That pronouns have more inflexions than nouns, may be seen by comparing the inflexions of *man* with the pronoun *he*, which is that noun's substitute.

	Sing	*Plural*	*Sing*	*Plural*
Nom.	man	men	He	They
Poss.	man's	men's	his	theirs
Obj.	man	men	him	them

In the above examples '*man*' becomes *man's*, *men*, *men's*, whereas 'he' becomes *his*, *him*, *they*, *theirs* and *them*.

3. Prepositions of *place*:—*in*, *on*, *at*, *by*, *under*, etc., as 'a horse *in* the stable;' 'a field *by* a river.'
Of *time*:—*after*, *before*, during, till, etc., as, He arrived after three o'clock, before six, during a storm.
Of *course*:—*from*, *with*, *by*, of. He died *of* hunger, *by* the sword, *from* want.

Geography.

1. The *Guadalquivir* rising on the borders of Granada flows in a southwesterly direction to the Atlantic, having for its basin the whole plain of Andalusia bounded on either side by the Sierra Morena and the Sierra Nevada. Though its length is but 350 miles, yet it flows through one of the most lovely valleys, of which the following is a description. 'The plains of Andalusia, notwithstanding their being situated in one of the warmest climates of Europe, are still, generally speaking, of a moderate temperature. In them are found myrtles, palm trees, olives, bananas, orange and lemon trees, with other productions of a warm climate, and in some spots the sugar cane and cotton grow. The orange and lemon trees, particularly around convents, form groves of considerable extent, which, in the time of blossoming send forth a most delicious perfume. At that season the inhaling of these odours gives a delightful sensation of the salubrity of the air. The soil is so productive that the husbandman with very little trouble can raise an abundant harvest. The river, therefore, seems to flow through an earthly paradise.

The *Rhone* rising in Mount St. Gothard flows south-west to its confluence with the Drance at Martigny, where is the road to the grand scenery of the Alps. It then enters L. Geneva as a muddy stream, but on leaving this beautiful lake it is of the finest blue. It immediately enters a rocky gorge, where it is lost to view, flows past Mont Cenis, and then bends to the westward to join the Saone. From this point it flows south to the Mediterranean through a valley whose slopes are almost everywhere planted with vines, forming some of the finest vine-yards of France. It traverses some beautiful districts well adapted for the cultivation of the mulberry, and so the silkworm thrives and causes this part of France to be the best silk-producing portion of the country. These facts, combined with the passing of the upper course of the river through the picturesque Canton of Vallais, and its enlargement to form Lake Geneva, of world-wide fame and historical interest, render the Rhone a stream having no mean claim to be one of the finest, as it is the most rapid river in Europe.

The *Rhine* rises in Mount St. Gothard, takes a north-east direction through the magnificent ravine of the Rheinwald enclosed with rocks 3,000 feet high, and covered to their summits with firs. It unites with another stream and flows through a romantic valley to Lake Constance, after leaving which lake it forms the magnificent and renowned falls of Schaffhausen. At Basle the Rhine turns north and flows onward to empty itself by a delta into the North Sea. Of this beautiful river it has been said that from its source to Basle, wildness, grandeur, and romantic beauty characterize it in every part. But the scenery most generally admired lies between Mentz and Bonn. The Rhine here pursuing a meandering course is pent between lofty and craggy mountains, and resembling rather a succession of lakes than a river. These mountains are mountains in miniature, with groves now and again on their sides, each grove having a church spire rising in its midst, and overtopping the trees. Frequently an ancient castle crowns some fantastic cliff and frowns over the river, or rises majestically from the brow of the steep.

The *Danube* is a river of the first rank, and the second of European rivers, being only inferior to the Volga. Its course is calculated to be about 1770 miles, and it drains a surface at least 300,000 square miles in area. It is augmented by 60 large tributary rivers, and passes into the Black Sea, nearly as great a volume of water as all the other rivers that flow into that sea. Geographers divide the course of the river into three parts. Its upper course is through the hilly country about its source, the Bavarian plain, and the mountains which divide that plain from the plains of Hungary; the middle course extends from Vienna to the 'Iron Gate,' which divides the Hungarian from the Wallachian plain; and the lower course traverses the last-mentioned plain. The upper course passes through the far-famed scenery of the Black Forest, and the wide and fertile plains of Bavaria, rich in corn, flax, and fruits, and even here the river by means of steam navigation promotes internal communication. The middle course flows through a district which excels almost any country in Europe for natural productions. The Hungarian wheat is of the finest quality and well known in the French and English markets: the breed of horned cattle is one of the finest in Europe, and the yearly production of Hungarian wine is something enormous. Below Belgrade where the Danube is joined by the Save, the river flows for sixty miles through an undulating tract, until its bed is narrowed by the approach of the Carpathians and Balkans. Near the termination of this defile is the famous pass of the 'Iron Gate,' a deep gorge 2000 yards long, enclosed on either side by mountains of slate, and through which the river rushes with great velocity, and a deafening noise. With the exception of the delta, and its course between Bulgaria and Wallachia, the scenery on the Danube is picturesque and impressive, at one time flanked by mountains, and again by far extending forests.

3. *See same question under 'Candidates' in this number of magazine.*

History.

		A.D.
1.	Egbert began to reign	827
	Ethelwulf "	836
	Ethelbald "	857
	Ethelbert "	860
	Ethelred I. "	866-871

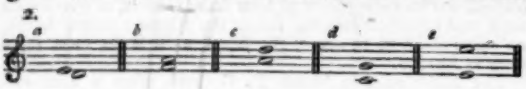
2.	A.D.		A.D.
William I. began to reign	1066;	suc. by William II. (Rufus)	1087
Henry II. "	1154;	" Richard II.	1189
Edward I. "	1272;	" Edward II.	1307
Richard II. "	1377;	" Henry IV.	1399

3.

		A.D.
Charles I. began to reign		1625
(*Commonwealth intervened from* 1649-60)		
Charles II.	restored	1660
James II.	succeeded	1685, dethroned 1688
William III. and Mary II.	,,	1689
Anne	,,	1702
George I	,,	1714

Music.

1.

2.

3. Eight.
Eight.
Three.

SECOND YEAR.

Pupil Teachers at end of Second Year.

Three hours and a half allowed.

Arithmetic.

MALES.

1. If an army when reduced 15·8 per cent. by sickness number 8841 men, what was the original number of the army?

2. Find simple interest on £34,675 for 17 days at 5 per cent. per annum?

3. If £189 16s. 6d. amounts to £211 8s. $4\frac{32}{100}$d. in three years and a half, at simple interest, what is the rate per cent. per annum?

4. A man who has a house worth £3000 insures it at $\frac{2}{3}$ of its value at 3s. 3d. per cent., what yearly premium does he pay?

5. The $3\frac{1}{2}$ per cents. are at 95$\frac{1}{2}$; I wish to derive an income of £280 from investing in them; what amount of money shall I require?

FEMALES.

1. Reduce $7\frac{1}{4} - 4\frac{1}{10} - \frac{3}{11} + 1\frac{3}{44}$ to its lowest terms.

2. Express $\frac{3}{4}$ of $\frac{7}{11}$ of £1 14s. + $\frac{5}{8}$ of $\frac{1}{3}$ of £1 10s. + $8\frac{1}{2}$ of $\frac{1}{51}$ of 5s. as the fraction of £20.

3. The factors of a certain number are $\frac{7}{15}$, $2\frac{1}{2}$, $1\frac{1}{4}$, and $5\frac{1}{3}$; what is $3\frac{1}{2}$ of $\frac{3}{11}$ of $\frac{1}{2}$ of the number?

4. I sold a house to A for $\frac{1}{8}$th more than it cost me. A sold it again to B for £18 13s. 4d., which was $\frac{1}{6}$th less than it cost him. What did the house cost me?

Grammar.

1. 'The *service done*, the mourners stood *apart;* he called to mind how he had seen her *sitting* on that *very* spot, and how her book had *fallen* on her lap as she was gazing with a pensive face upon the sky. *Another* told how he had wondered *that one* so *delicate* as she, should be so bold; how she had never *feared* to enter the church *alone* at night.'

(*a.*) Point out the 'subordinate' conjunctions in the above. State to which class of subordinate conjunctions each belongs, and show why such conjunctions are called subordinate.

(*b.*) Parse the words in italics.

2. How can you tell when the following words are used as adverbs, and when as conjunctions—*after, before, since?* Give examples of them in both uses.

Geography.

ANSWER Q. 1 *or* Q. 3; *not both.*

1. The subject for a prize-theme at a school was:—'*Which is the finest river in Europe?*' Four boys tried for the prize; one born at Seville, one at Lyons, one at Cologne, one at Buda-Pesth, and each chose his own river. What did each find to say; and which, do you think, ought to have got the prize?

2. Draw a full map of Hindostan.

3. Name six important places in British North America, and say what you know of each.

SECOND PAPER.

One hour allowed for Females.
Two hours and a half allowed for Males.

History.

1. What was the hereditary kingdom of Alfred? For what services to his country does this prince deserve to be called 'the Great'?

2. Why is the mother of Henry II. known as 'the Empress' Maud? Who was her second husband, and what line of kings descended from that union?

3. The later years of Edward III. were darkened by disputes between the barons and the commons and between the barons and the clergy; give some account of these disputes.

Penmanship.

Write, in large hand, as a specimen of copy-setting, the word *Witherslack.*

Write, in small hand, as a specimen of copy-setting, *There are fifteen English yachts at Trouville.*

Composition.

Write full notes of a lesson on *A Manufacturing Town.*

Euclid.

[All generally understood abbreviations for *words* may be used, but symbols of *operation* are not admissible.]

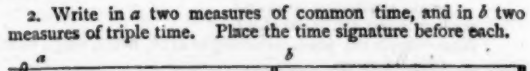
1. Upon the same base, and on the same side of it, there cannot be two triangles that have their sides which are terminated in one extremity of the base, equal to one another, and likewise those which are terminated in the other extremity.

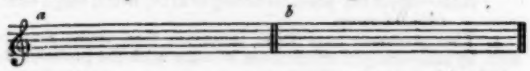
2. If two triangles have two sides of the one equal to two sides of the other, each to each, but the angle contained by the two sides of one of them greater than the angle contained by the two sides equal to them of the other; the base of that which has the greater angle, shall be greater than the base of the other.

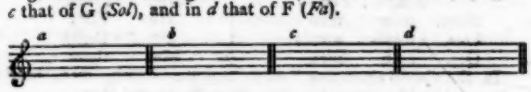
Show that without the restriction in the construction there would be three cases.

Music.

1. Write, under each of the following, the name and quality (major, perfect, or other) of the interval it forms:—



2. Write in *a* two measures of common time, and in *b* two measures of triple time. Place the time signature before each.

3. Write in *a* the signature of D (*Re*), in *b* that of B♭ (*Se*), in *c* that of G (*Sol*), and in *d* that of F (*Fa*).



ANSWERS.—SECOND YEAR.

Arithmetic.

MALES.

1. A loss of 15·8 p.c. leaves $\frac{84{\cdot}2}{100}$ of the whole, ∴ the whole =

$$8841 \times \frac{100}{84{\cdot}2} = \frac{884100}{84{\cdot}2} = \underline{10500} \text{ men. Ans.}$$

2. Simple interest = £34,675 × $\frac{17}{365}$ × $\frac{1}{100}$ =

$$\frac{£346{\cdot}75 \times 17}{73} = £4\ 15s. \times 17 = \underline{£80\ 15s.} \text{ Ans.}$$

3.

	£	s.	d.
Amount =	211	8	$4\frac{32}{100}$
Principal =	189	16	6
∴ Interest =	21	11	$10\frac{32}{100}$

∴ rate p. c. = £21 11s. $10\frac{32}{100}$ × $\frac{1}{3\frac{1}{2}}$ × $\frac{£100}{£189\ 16s.\ 6d.}$ =

$$£\frac{2072889}{400 \times 240} \times \frac{7}{1} \times \frac{100 \times 240}{45558} = £\frac{2072889}{91116} = \underline{£3\tfrac{1}{2}}.$$

4. $\frac{2}{3}$ of £3000 = £1800; Premium on £100 = 3s. 3d.

∴ ,, £1800 = £2 18s. 6d.

5. $£3\frac{1}{2}$ are got from $£95\frac{5}{8}$

$\therefore £280$,, $£95\frac{5}{8} \times \frac{280}{3\frac{1}{2}}$

,, ,, $£\frac{763 \times 560}{8 \times 7}$

i.e. $£109 \times 70 = £7630$. Ans.

FEMALES.

1. $7\frac{3}{4} - 4\frac{5}{12} - \frac{3}{21} + 1\frac{3}{42} = (7\frac{9}{12} - 4\frac{5}{12}) = 3\frac{1}{2}$;
$(3\frac{7}{21} - \frac{3}{21}) = 3\frac{4}{21}$; $(3\frac{1}{2}\frac{3}{2} + 1\frac{3}{42}) = 4\frac{1}{14}$.

2. (*a*) $\frac{3}{5}$ of $\frac{9}{17}$ of $£1$ 14s. $= \frac{3}{17}$ of 34s. $= 8$

$\frac{5}{6}$ of $\frac{3}{8}$ of $£1$ 10s. $= \frac{30s. \times 5}{6 \times 8} = 3\frac{1}{2}$

$8\frac{1}{4}$ of $\frac{1}{11}$ of 5s. $= \frac{5s. \times 33}{4 \times 11} = 3\frac{1}{4}$

Total $= 14\frac{3}{4}$.

(*b*) $14\frac{3}{4}$s. to the fraction of $£20 = \frac{59}{1600}$.

3. The number may be represented by $(\frac{7}{12} \times \frac{33}{4} \times \frac{11}{14} \times \frac{21}{4})$ and
$\therefore \frac{25}{36}$ of $\frac{7}{12}$ of $\frac{8}{9}$ of $\frac{7}{12} \times \frac{33}{4} \times \frac{11}{14} \times \frac{21}{4} =$

$\frac{32 \times 8 \times 3 \times 7 \times 21 \times 11 \times 21}{9 \times 21 \times 5 \times 12 \times 8 \times 14 \times 4} = 51\frac{2}{3}$.

4. A must have bought the house for $\frac{7}{8}$ of original price, and he sold it to B for $\frac{5}{8}$ of $\frac{7}{8}$ original price, *i.e.* $\frac{35}{64}$ of original price,
and $\therefore$ cost price $= £18$ 13s. 4d. $\times \frac{64}{35} = £19$ 4s.

Grammar.

1. The only subordinate conjunctions in the given passage are, (4) 'how,' (1) 'that,' and (2) 'as.' 'How' (= that), and 'that' may be called *simple* cunjunctions of subordination, 'as' (1) (= while) is a conjunctive-adverb or *adverbial*-conjunction, and 'as' (2) is a *comparative* conjunction.

Subordinate conjunctions are those which unite sentences o fwhich one is in a relation of dependence upon the other, that is to say, enters into its construction with the force of a substantive or an adverb.

(*b*) *service*—abst. noun, neut., sing., forming with
done—complete part., of *do, did, done* the nom. absolute.
apart—adv. of place modifying *stood*.
sitting—incomplete part, of irreg. intrans. v. *sit, sat, sat* agreeing with *h.r.*
very—disting., adj., pointing to *spot*.
fallen—complete part. of irreg. intrans. v. *fall, fell, fallen*, forming with *had*, a compound tense.
another—indef. pron. 3rd pers. sing., mas., nom. subj. of *told*.
that—a simple conjunction of subordination introducing the subord. sent., '*one should be so bold*.'
one—indef. pron., 3rd. pers., sing., fem., nom., subj. of *should*.
delicate—adj. of quality, qual., *one* (used predicatively.)
feared—complete part. of reg. intrans. v., *to fear* forming with *had* a compound tense.
alone—adv. of manner mod. *to enter*.

2. *After, before*, and *since* when conjunctions stand at the beginning of the clauses which they govern as, 'I hope to hear from you—*after* you return,'—'*before* you leave'—'*since* you must go.' As adverbs they modify the meaning of the verb 'I shall go *before*.' 'You can follow *after*.' I have not seen him *since*.

Geography.

1. *See same question answered under 'First Year' in this number of Magazine.*

3. *Ottawa*. Seat of Government of the Dominion of Canada—in the province of Ontario—formerly called Bytown—stands at the junction of the Rideau Canal with the Ottawa.

Quebec is the capital of the province of Quebec—on the north bank of the river St. Lawrence—is very strongly fortified, and has an extensive trade. Taken from the French by Wolfe, in 1759.

Montreal, in the province of Quebec, on the S. E. side of the island of Montreal at the confluence of the St. Lawrence and the Ottawa, has a thriving trade, and close to it is the tubular bridge, 1¼ miles in length, which carries the Grand Trunk Railway over the St. Lawrence.

Halifax, the capital of Nova Scotia, on the S. E. coast, has an extensive trade, and its noble harbour is the chief naval station of British America.

St. John's, chief town of Newfoundland, on the S. E. coast, is strongly fortified, and has a great trade in connection with the cod fishery.

St. John, the principal seaport of New Brunswick, on the Bay of Fundy, at the mouth of the river St. John, suffered greatly by fire four years ago (1877).

History.

1. The hereditary kingdom of Alfred was *Wessex*. He is entitled to the name 'Great' from the following considerations. In addition to the military organisation of the country, Alfred did much to improve the social condition of his subjects; established schools, and translated many Latin books into Anglo-Saxon for the instruction of the people; wrote several historical and geographical works; invited learned foreigners to settle in England; encouraged the arts and sciences, commerce and manufactures; formed a system of wise laws, and laid the foundation of many of those institutions which have contributed so much to the prosperity and greatness of Britain.

2. The mother of Henry II. is known as 'the Empress' Maud, because she married the Emperor Henry V., of Germany. Being left a widow, she married Geoffrey Plantagenet, and from this union sprung the royal line of Plantagenets.

3. Towards the close of the reign of Edward III., all the French conquests being lost, the shores of England insulted, and her fleets annihilated, the feudal baronage in their distress looked to the riches of the clergy, who held more than a third of the soil in landed property. Heavy taxes were imposed on Church lands, and a policy of confiscation was planned. The baronage, however, were powerless before the parliament of 1376, in which the knights of the shire united with the burgesses in a joint attack on the Royal Council. This parliament, through their speaker, La Mare, denounced the mismanagement of the war, the enormous taxation, and demanded an account of the expenditure. They received countenance and support from the Black Prince, but the death of the latter interrupted the work of reform. The greed of the triumphant barons, called to a new parliament by Lancaster, broke out in fresh strife with the Churchmen, who had, for some reason or other, supported the people. In the new plans of spoliation they were supported by John Wyclif, who saw in the anxiety of John of Gaunt and his followers to seize on the wealth of the prelates an opportunity to attempt the reform of the Church.

Notes on *A Manufacturing Town*.

DEFINITION.—A manufacturing town is one in which are situated works for manufacturing various materials, such as cotton, wool, flax, etc., into cloth of all kinds—names of these to be got from the children—calico, muslin, flannel, serge, linen, etc., specimens easily obtained.

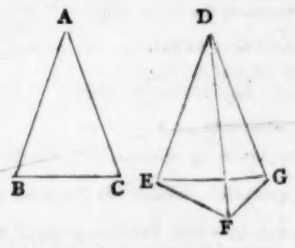
DESCRIPTION.—*Where situated*.—In localities where plenty of fuel can be got—where sea, river, or rail is convenient for bringing the raw material, and for carrying it off in the manufactured state. *Examples*.—Iron districts of England and Scotland always connected with coal give our country pre-eminence in working up iron. Cotton and woollen districts flourish near the same fields. Sea, a highway for bringing raw cotton to Lancashire. Yorkshire produces the wool which is there wrought up. Forfar receives its flax by sea from the shores of the Baltic. *Character*.—Compared with other towns they, having a greater population of the humbler classes, are neither so clean nor so well conducted (effect of the crowd on the streets at meal-hour); the immense traffic and general bustle of business—smoky and unhealthy atmosphere to be noted—advantage to be taken of asking information from children who have visited such towns.

EXAMPLES.—*Woollen*.—Leeds, as a centre, in England. Hawick, in Scotland. *Linen*.—Belfast, in Ireland, Dundee in Scotland. *Cotton*.—Manchester, in England. *Iron*.—Barrow-in-Furness, Middlesboro', in England. Glasgow, and surrounding towns, in Scotland, etc.

Euclid.

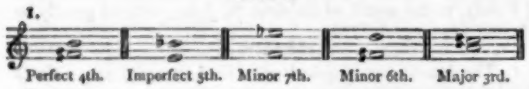
1. Prop. 7, Bk. 1.

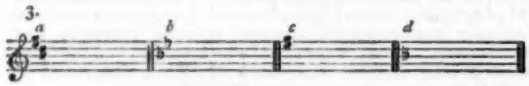
2. Prop. 24, Bk. 1. Without the restriction in the construction there would be in all three cases to consider, two besides that in Euclid. The point F might fall *on* EG, or *above* EG, as well as *below* EG. If F falls *on* EG it is obvious that EF is less than EG, and if F falls *above* EG, the sum of DF and EF is less than the sum of DG and EG (I. 21),



and $\therefore$ EF is less than EG.

Music.

1.

2.

3.

THIRD YEAR.

Pupil Teachers at end of Third Year, *if apprenticed on, or after, 1st May,* 1878; **and Pupil Teachers at end of Fourth Year,** *if apprenticed before that date.*

Three hours and a half allowed.

Arithmetic.

MALES.

1. What percentage of £20 is 7s. 6d.? and what percentage is $\frac{3}{10}$ of a gallon of $\frac{3}{10}$ of a barrel?

2. What should be the price per £100 of 3 per cent. stock in order that, after deducting an income tax of 4d. in the £, it may yield $3\frac{1}{2}$ per cent. interest to an investor?

3. A farmer having $37\frac{1}{2}$ score of sheep sold 8 per cent. of them to A., 90 of them to B., and $3\frac{1}{3}$ per cent. of the remainder to C. How many sheep had he left?

4. If 40 per cent. be gained by selling sugar at 1s. 3d. a lb., what per cent. will be gained by selling it at 5 0238095 guineas per cwt.?

5. What would be the difference in annual income from investing £3,450 in the 4 per cents. at 92, and in the $3\frac{1}{2}$ per cents. at 69?

FEMALES.

1. Divide ·8 by 476·3 and 36·34 by 674, each to four places of decimals, and prove the truth of each result.

2. Convert into decimals $2\frac{1}{2}$ of $8\frac{1}{2}$ — $\frac{1}{2}$ of $1\frac{1}{2}$ of $\frac{7}{8}$ + $\frac{1}{3}$ of $7\frac{1}{11}$.

3. A corn dealer bought 198 bushels of barley for £32·5875, 100 bushels of which he sold for £·2375 a bushel. At what price per quarter may he sell the remainder so as to gain £2·1875 by his bargain?

Grammar.

1. 'And waiting to be treated like a wolf
Because I knew my crimes were known, I found
Instead of scornful pity, such a grace
Of tenderest courtesy, that I began
To glance behind me at my former life,
And find that it had been the wolf's indeed.'

TENNYSON.

(*a.*) Point out the noun sentences in the above and analyse them.

(*b.*) Point out any enlargement of the subject or extension of the predicate that you notice in the above.

(*c.*) Parse all the participles and verbs in the infinitive mood that occur in the above.

2. Of what Latin prepositions are the following words compounded:—Amputate, efface, circuit, collision, preface, succeed, suffuse, sojourn, tradition.

Geography.

1. Draw a full map of Hindostan.

2. Give full notes of a lesson on the River Nile.

SECOND PAPER.

One hour allowed for Females.
Two hours and a half allowed for Males.

History.

1. What efforts were made to disturb the throne of Henry VII.?

2. Who was Oliver Cromwell? Sketch his character and career.

3. The last European war in which England engaged was with Russia; mention the cause of the quarrel, the result of the war, and our allies.

Penmanship.

Write, in large hand, as a specimen of copy-setting, the word *Withers'lack.*

Write, in small hand, as a specimen of copy-setting, *There are fifteen English yachts at Trouville.*

Composition.

Write from memory the substance of the passage read to you by the Inspector.

Euclid.

[All generally understood abbreviations for *words* may be used.]

1. The straight lines which join the extremities of two equal and parallel straight lines towards the same parts, are also themselves equal and parallel.

2. If a parallelogram and a triangle be upon the same base and between the same parallels; the parallelogram shall be double of the triangle.

O is any point within a parallelogram ABCD, and lines are drawn from it to the angles. Show that the triangles OAB, OCD are together equal to the triangle ABC.

Algebra.

1. Prove the rule for subtracting algebraical quantities.

Simplify $\{2x-(3y-z)\}-\{y+(2x-z)\}+\{3z-(x-2y)\}-\{2x-(y-z)\}$

2. Prove the rule for dividing an algebraical fraction by an integer.

Reduce to the simplest form:—

$$\frac{x^2-9x+20}{x^2-6x}\times\frac{x^2-13x+42}{x^2-5x}\div\frac{x-7}{x^2}$$

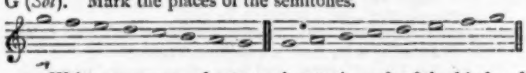
3. Solve the equations:—

1. $\frac{2x}{3}-\frac{1-\frac{1}{2}x}{4x}=\frac{-1}{2}+\frac{x}{6}$

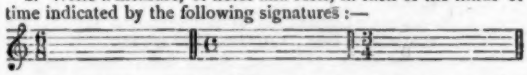
2. $\frac{x-1}{x+3}-\frac{2x-1}{3x+1}=\frac{1}{3}$.

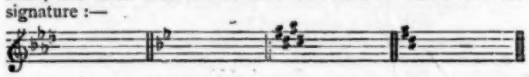
Music.

1. Complete the following (by inserting the necessary sharps or flats) as a descending and ascending diatonic minor scale of G (*Sol*). Mark the places of the semitones.



2. Write a measure, of notes and rests, in each of the kinds of time indicated by the following signatures:—



3. Write over each of the following the name of the major scale, and under each that of the minor scale of which it is the signature:—

ANSWERS.—THIRD YEAR.

Arithmetic.

MALES.

1. (*a*) 7s. 6d. $=\frac{3}{160}$ of £20, or $\frac{3\times100}{160}$ p. c. $=1\frac{7}{8}$.

(*b*) $\frac{3}{10}$ gall. $=\frac{\frac{3}{10}}{15}$ of $\frac{3}{10}$ of a barrel of 36 galls. or $\frac{3\times100}{150}$ p. c. $=\underline{2}$.

2. £$3\frac{1}{2}$ is made by investing nominally £100.
£1 " " £$\frac{200}{7}$.
$\frac{1}{10}$ of £3 " " $\frac{1}{10}$ of £$\frac{200}{7}$
$\therefore$ £$\frac{600\times236}{240\times7}$ = £$5\frac{10}{7}$ = £$\underline{84\frac{3}{7}}$. Ans.

3. 8 p. c. of $37\frac{1}{2}$ score $=\frac{8}{100}$ of 750 = 60 sold to A.;
90 more sold to B, leave (750 − 150) = 600;
$3\frac{1}{2}$ p. c. of 600 $=\frac{600\times7}{200}=21$.
$\therefore$ the No. of sheep left = 600 − 21 = $\underline{579}$ Ans.

4. 5·0238095 gui. = £5 5s. 6d. price of 1 cwt.
112 lbs. at 1$\frac{1}{2}$s. = 140s. = £7 "
Prime cost = 140s. × $\frac{210}{200}$ = 100s.
$\therefore$ to sell at 105$\frac{1}{2}$s. gives a gain of 5$\frac{1}{2}$ p. c.

5. Difference of income $= £3450 \times \left(\frac{3\frac{1}{2}}{69} - \frac{4}{92}\right)$

$= £3450 \times \frac{1\frac{1}{2} - 1}{23}$ or $\frac{1}{20}$ r

$= £\frac{3450}{207} = £\frac{150}{9} = £16\ 13s.\ 4d.$ Ans.

FEMALES.

1. (*a*) $476{\cdot}3 \overline{)8000} (\underline{{\cdot}0016}.....$

4763

32370

28578

37920

Proof by fractions—

$8 \div 476{\cdot}3$

$= \frac{8}{1} \div \frac{4763}{10}$

$= \frac{8}{1} \times \frac{10}{4763}$

$= \frac{80}{4763} \times \frac{10000}{10000}$

$= \frac{80000}{4763} \times \frac{1}{10000}$

Now $\frac{80000}{4763} = 16$.....from above ;

$\therefore$ the result $= \frac{16}{10000}$

$= {\cdot}0016.$ ....

(*b*) $674) 36{\cdot}34 (\underline{{\cdot}0539}.....$

3370

260

2022

6180

6066

114

Proof by fractions—

$36{\cdot}34 \div 674$

$= \frac{3634}{100} \div \frac{674}{1}$

$= \frac{3634}{100} \times \frac{1}{674}$

$= \frac{3634}{674} \times \frac{1}{10000}$

$= \frac{5390}{674} \times \frac{1}{10000}$

Now $\frac{5390}{674} = 539$.....by the above.

$\therefore$ the result $= \frac{539}{10000} = {\cdot}0539$.....

2. $2\frac{3}{5}$ of $8\frac{3}{4} = \frac{13 \times 35}{5 \times 4} = \frac{91}{4} =$ 22·75

Subtract $\frac{1}{2}$ of $1\frac{3}{8}$ of $\frac{7}{8} = \frac{1 \times 5 \times 7}{2 \times 3 \times 8} = -\frac{35}{48} =$ − ·72916

22·02083

Add $\frac{11}{12}$ of $7\frac{4}{11} = \frac{11 \times 81}{12 \times 11} = \frac{81}{12} =$ 6·75

28·77083

3. Cost price of 198 bush. ... ... = 32·5875

Profit required = 2·1875

Selling price of whole ... ... = 34·775

,, 100 bush. ... = 23·75

,, 98 bush. or 12¼ qrs. = 11·025

$\therefore$ price per qr. $= £\frac{11{\cdot}025}{12\frac{1}{4}} = £\frac{44{\cdot}1}{49} = £{\cdot}9$ or 18s. Ans.

Grammar.

1. (*a*) Noun sentences—(a_1) '*(that) my crimes were known.*'
(b_1) '*that it had been the wolf's (life) indeed.*'

Analysis of (a_1) *(that)* .....connective.
my crimes .....subject and enlargement
were known.....complete predicate.
,, (b_1) *that*.....connective.
it.....subject.
had been .....incomplete predicate.
the wolf's (life) completion of predicate
indeed..... ...extension of predicate (*degree*).

(*b*) '*Waiting to be treated like a wolf*'—enlargement of subject '*I.*'
'*my*'—enlargement of subject '*crimes.*'
'*Instead of scornful pity*' is extension of predicate '*found.*'

(*c*) *Waiting*—incomplete part. of the reg. intrans. v. *to wait*, agreeing with *I.*
to be—pres. indef. infin. of *am, was, been*, forming with *treated*—complete part. of the reg. v. *to treat*, pres. indef. infin. passive voice.
known—complete part. of the trans. v. *know, knew, known*, forming with *were* past indef. indic. pass. voice.
to glance—pres. indef. infin. of the reg. v. *to glance*, gov. by *began.*
(*to*) *find* pres. ,, ,, ,, irreg. v. *find, found, found*, gov. by began.
been—complete part. of *to be*, form. with *had* the past perf. indic. of the verb *to be.*

2. Amputate is compounded with the prep. *Ambi*—'about.'

efface	,,	*ex*—'of, out of.'
circuit	,,	*circum*—'about.'
collision	,,	*con*—'together.'
preface	,,	*pre*—'before.'
succeed	,,	*sub*—'under.'
suffuse	,,	i.l. id.
sojourn	,,	id. id.
tradition	,,	*trans*—'across.'

Geography.

Notes of a lesson on the *Nile.*

SOURCE.—In Lake Victoria Nyanza about 4000 ft. above sea-level. Lake discovered by Speke 1858, circumnavigated by Stanley 1875. Albert Nyanza another great reservoir of the Nile.

COURSE.—Main branch, Bahr el Abiad, or White Nile, flows in a N.W. direction for 800 miles; unites at Khartoum with the Bahr el Azrek; these form one large stream; enters the Mediterranean by a delta of two great arms, the two chief mouths being at Rosetta and Damietta.

TRIBUTARIES.—After leaving Victoria Nyanza, receives on W. Bahr el Ghazal, then from E. Giraffe and Sobat, the only other trib. besides the Bahr el Azrek is the Atbara or Tacazze from Abyssinia joining it on the right.

TOWNS ON ITS BASIN.—Damietta, Rosetta, Alexandria, Cairo, Beni-Souef, Siout, Kenneh, Thebes (ruins), Esneh, Assouan, Derr, Ipsambul, New Dongola, Berber, Meroë, Shendi, Khartum, *On B. el Azrek*, Khartum, Senaar, Gondar.

REMARKS AND CHARACTER.—One of the most celebrated rivers in the world; numerous attempts made to discover the source; river an object of veneration to the ancients; its valley very much confined in Nubia and Upper Egypt; most curious fact connected with the river is its annual *inundation*; this overflow makes Egypt a fertile country, which otherwise would be desert; inundation due to rains of Abyssinia and basin of Nyanza; river rises about thirty-one feet at Thebes and four at its mouths; overflow begins in Lower Egypt about midsummer; increases for three months; is stationary for twelve days; year after year same phenomenon recurs, almost always within a few hours of the same time, and within a few inches of the same height. It is a navigable stream from its junction with the Bahr el Azrek.

History.

1. In 1486, several risings of Yorkists, got up by the former partizans of Richard III., were easily suppressed. More formidable attempts, however, were to come in the shape of two impostures, strongly supported by Edward IV.'s sister, Margaret, Duchess Dowager of Burgundy. In 1487, a low-born impostor, named Lambert Simnel, was encouraged by the Yorkist faction to declare himself the young Earl of Warwick, whom Henry had imprisoned in the Tower. He was well received in Ireland, but, having landed in England with 2000 troops, was defeated at Stoke by the Royal troops. The Earl of Lincoln, who had actively supported Simnel, was slain in the battle, and the impostor became an assistant in the Royal scullery.

In 1492, a second and more troublesome impostor, named Perkin Warbeck, started up and kept his cause floating for five years before the public. This pretender gave out that he was the Richard, Duke of York, son of Edward IV., who was believed to have been murdered in the Tower. He also was well received in Ireland, was acknowledged by Margaret of Burgundy, and on visiting Scotland was kindly treated by James IV., who married him to a daughter of Lord Huntly. Being compelled to leave Scotland in 1497, he landed in Cornwall, and was soon at the head of a considerable force. On the approach of the Royal army, he meanly left his followers, surrendered, and was imprisoned in London. In 1498 he escaped, was recaptured, confessed his imposture, and was hanged.

2. Oliver Cromwell was the son of Robert Cromwell, and born at Huntingdon, 1599. He was returned as member for his native town to the third Parliament of Charles I., 1628. He was again elected in 1640. He was associated with Hampden,

Pym, and other popular leaders, and was one of the first to advocate resistance to the King's measures. In 1642 he received a captain's commission, and raised a troop of horse in his native county. So well were his soldiers disciplined, that after the battle of Marston Moor they got the name of Cromwell's Ironsides. At Naseby, Cromwell commanded the right wing, and Ireton, his son-in-law, the left. Charles was totally defeated in this battle, and ultimately gave himself up to the Scots at Newark. In 1649, when it was settled at his trial that the king should be executed, Cromwell is said to have reluctantly assented; but when convinced of the necessity of Charles's death, he seems to have had no hesitation in carrying the decision of the court into effect. After the execution, Cromwell became a principal member of the Council of State. He quelled a mutiny in the army, crossed over and conquered Ireland, returned to make war on Prince Charles and the Scots, whom he conquered at Dunbar and Worcester. In 1653 he expelled the Long Parliament, and was elected Protector of the Commonwealth, which office he held till his death in 1658.

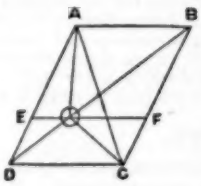
Cromwell has now come to be regarded as one of Eng'and's greatest rulers. He was a man of most marvellous genius, who after the age of forty became an invincible general and a wise statesman. He was a zealous patriot, and an enthusiast in religion. To him are we indebted for the great lesson of religious toleration.

3. The ambition of Russia was the immediate cause of the war. The Emperor Nicholas aiming at the possession of Constantinople, and making a pretext of quarrel out of Turkey's treatment of her Christian subjects in 1853, invaded Turkey. *England* and *France* united with *Turkey* in opposition to the designs of Russia, and towards the close of the war *Sardinia* joined the cause of the allies by sending 5000 men. After the destruction of Sebastopol, the war ended with the *Treaty of Paris*, signed on March 30th, 1856. By the terms of this peace the Russian Protectorate in the principalities of Moldavia and Wallachia was abolished, the freedom of the Danube and its mouths was established, and the Christian subjects of the Sultan were placed under the protection of England, France, Russia, Austria, and Sardinia.

Euclid.

1. Prop. 33, Bk. I.

2. Prop. 41, Bk. I. *Rider.* From any point O within the parallelogram ABCD, let OA, OB, OC, OD be drawn to the angles A, B, C, D; then the triangles AOB, DOC, shall be together equal to the triangle ABC, that is, to half the parallelogram, for the diagonal AC bisects it.



Through O draw EOF parallel to AB or DC. Then the figures ABFE, EFCD, are parallelograms. Because the triangle AOB, and the parallelogram ABFE are on the same base, AB, and between the same parallels, AOB is = half of ABFE. For the same reason DOC is = to half of EFCD. But ABFE, EFCD, make up the whole figure ABCD ∴ AOB, DOC are together = to half ABCD. That is to the triangle ABC.—Q.E.D.

Algebra.

1. Suppose we have to take $b+c$ from a. Then as each of the numbers b and c is to be taken from a the result is shown by $a-b-c$. That is $a-(b+c)=a-b-c$. Next, suppose we have to take $b-c$ from a. If we take b from a we obtain $a-b$; but we have taken too much from a, for we were required to take not b but $b-c$, that is b diminished by c. Hence we must increase the result by c; thus:—

$$a-(b-c)=a-b+c.$$

From the consideration of these cases we arrive at the following rule:—*Change the signs of all the terms in the expression to be subtracted and then add it to the other expression.*

$$\begin{aligned} &\{2x-(3y-z)\} &&= 2x-3y+z\\ -&\{y+(2x-z)\} &&= -2x-y+z\\ &\{3z-(x-2y)\} &&= -x+2y+3z\\ -&\{2x-(y-z)\} &&= -2x+y-z\\ \hline & && -3x-y+4z \end{aligned}$$

2. To divide a fraction by an integer we may either (1) *multiply the denominator*, or (2) *divide the numerator by it.*

(1) $\frac{a}{b} \div n = \frac{a}{bn}$; for in the fraction $\frac{a}{b}$ the unit is divided into b equal parts, a of which parts are taken; whereas in the fraction $\frac{a}{bn}$ the unit is divided into bn equal parts of which a parts are taken; now since each part of the latter fraction is $\frac{1}{n}$th of each part of the former, it follows that $\frac{a}{bn}$ is $\frac{1}{n}$ th part of $\frac{a}{b}$, hence $\frac{a}{b} \div n = \frac{a}{nb}$;

(2) $$\frac{bn}{a} \div n = \frac{bn}{an} = \frac{b}{a}.$$

The other form of the expression is

$$\frac{(x^2-9x+20)\,(x^2-13x+42)\,(x^2)}{(x^2-6x)\,(x^2-5x)\,(x-7)} = \text{(when broken up)}$$

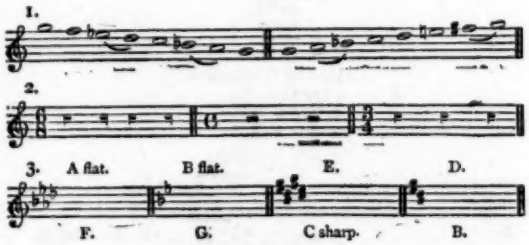
$$\frac{(x-5)\,(x-4)\,(x-6)\,(x-7)\,x^2}{x^2\,(x-6)\,(x-5)\,(x-7)} = \underline{x-4}. \quad \text{Ans.}$$

3. (1) Clearing of fractions we obtain

$$\begin{aligned} 8x^2-3+\tfrac{3}{2}x &= 6x^2-6x+2x^2\\ 8x^2-6x^2-2x^2+\tfrac{3}{2}x+6x &= 3\\ \tfrac{3}{2}x+6x &= 3\\ 15x &= 6\\ x &= \underline{\tfrac{2}{5}} \end{aligned}$$

(2) Clearing of fractions we obtain

$$\begin{aligned} 9x^2-6x-3-6x^2-15x+9 &= 3x^2+10x+3\\ 9x^2-6x^2-3x^2-6x-15x-10x &= 3+3-9\\ 31x &= 3\\ x &= \underline{\tfrac{3}{31}}. \quad \text{Ans.} \end{aligned}$$

Music.

FOURTH YEAR.

Pupil Teachers at end of Fourth Year, *if apprenticed on, or after,* **1st *May,* 1878; and Pupil Teachers at end of Fifth Year, if apprenticed before that date.**

Three hours and a half allowed.

Arithmetic.

MALES.

1. What interest (in £ s. d.) per cent. per annum is obtained from investing money in the 3 per cent. Consols at 91¾; brokerage ⅛ per cent.?

2. If iron, sold at the rate of £4·9875 per ton, yields a profit of 17 per cent., what must have been the expense (in £ s. d.) per ton of raising it?

3. A plumber sold 28S cwt. of lead for 31[illegible] guineas, and gained thereby at the rate of 12½ per cent. What did the lead cost him *per ton?*

4. What must be the price of £100 stock in the 3½ per cents., if an annual income of £3166 13s. 4d. can be secured by investing £80,071 8s. 6·8571428d. in them?

5. Two persons, A and B, together rent a field of 27½ acres for £38. One puts 30 sheep in for six weeks, and the other 20 sheep for 10 weeks. They agree to pay the rent and receive the profits according to the amount of feed taken by each, and they clear £57 by the sale of the hay. What are the rents, and profits, of A and B respectively?

FEMALES.

1. If 16·125 yards of calico, 1·375 yards wide, cost £2·2, what ought 45 yards ·875 yards wide, at the same price per yard to cost?

2. A man embarks his capital in four successive ventures. In the first he clears £100 per cent., and in each of the others he loses 20 per cent., show that there remains to him a profit 2·4 per cent. on his original outlay.

3. If $(2\frac{1}{2} \frac{2}{5}) \div (\frac{1}{8}$ of $3\frac{1}{3})$ of an acre of land be worth 35 guineas, what will 7 times $\left(\frac{7\frac{3}{4} - 4\frac{1}{2}}{\frac{1}{2}\text{ of }3\frac{1}{3}} \times \frac{7\frac{3}{5}}{31\frac{1}{5}}\right)$ of $2\frac{1}{2}$ acres be worth at the same rate?

4. £150 placed at a savings bank amounts in four years to £165; what is the rate per cent. per annum simple interest?

Grammar.

1. 'As for jest, there be certain things which ought to be privileged from it, namely, religion, matters of state, and any case that deserveth pity; yet there be some that think their wits have been asleep, except they dart out somewhat that is piquant, and to the quick; that is a vein that should be bridled.'

BACON.

(*a*) Analyse the above passage as far as 'deserveth pity.'

(*b*) Comment on the different uses of the word 'that' in the above.

(*c*) Give the meaning of the above passage in your own words.

2. Parse each word in the following:—

I knew one was wont to say in scorn: 'He must needs be a wise man, he speaks so much of himself.'

3. The ancient English is described as having been an 'inflexional' language to a much greater extent than the English we now use. Explain this statement, and mention any points you can think of in illustration of it.

Geography.

1. Give full notes of a lesson on the River Nile, and draw a map to illustrate the lesson.

2. What are '*currents*' in the ocean? Mention the chief currents that you know, and describe them minutely.

SECOND PAPER.

One hour allowed for Females.
Two hours and a half allowed for Males.

History.

1. When was our parliament divided into two houses? The parliament of 1376 has been called 'the good parliament'; why?

2. Who was the first crowned queen to suffer death on the scaffold in England? Narrate the circumstances.

3. Show how the throne passed from the Plantagenets to the Tudors, and from the Tudors to the Stuarts.

Penmanship.

Write, in large hand, as a specimen of copy-setting, the word *Witherslack*.

Write, in small hand, as a specimen of copy-setting, *There are fifteen English yachts at Trouville.*

Composition.

Write a short essay on *Heat, and its uses.*

Euclid.

[All generally understood abbreviations for *words* may be used.]

1. If a straight line be divided into any two parts, the rectangle contained by the whole and one of the parts, is equal to the rectangle contained by the two parts, together with the square on the aforesaid part.

What is the corresponding result in algebra?

2. In obtuse-angled triangles, if a perpendicular be drawn from either of the acute angles to the opposite side produced, the square on the side subtending the obtuse angle, is greater than the squares on the sides containing the obtuse angle, by twice the rectangle contained by the side upon which, when produced, the perpendicular falls, and the straight line intercepted without the triangle between the perpendicular and the obtuse angle.

3. The diagonals of a parallelogram are equal: find its angles.

Algebra.

1. Prove the rule for finding the G.C.M. of two algebraical expressions.

2. Solve the equations:

$$\left.\begin{array}{l}(1)\ 2(x+y) = 3(x-y) + 10\\ 2x - y = 4(2y - x) + 3\end{array}\right\}$$

$$(2)\ \frac{x+2}{x-1} - \frac{4-x}{2x} = 2\tfrac{1}{2}.$$

3. A number composed of two digits is equal to seven times its unit's figure; and if the digits be reversed, its value is increased by 18. Find it.

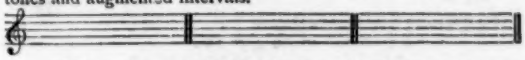
Mensuration.

1. Find the area of an equilateral triangle whose side is 25 ft.

2. A circle of radius 10.15 ft. falls entirely within another circle of radius 13.35 ft.; find the area between the circles.

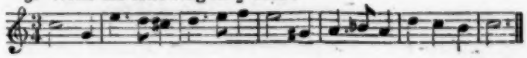
Music.

1. Write the upper tetrachord of G (*Sol*) minor, in every form with which you are acquainted. Mark the places of the semitones and augmented intervals.



2. Write, under each of the following pairs of notes, the name and quality (major, perfect, diminished, or other) of the interval it forms:—

3. Write the following in $\frac{3}{8}$ time:—



ANSWERS.—FOURTH YEAR.

Arithmetic.

MALES.

1. £91¾ + ½ or £91¼ brings £3 of interest.
£1 " $\frac{3}{91\frac{1}{4}}$
∴ £100 " $\frac{24 \times 100}{735}$
i.e., $\frac{100}{35}$ = £3 5s. 3$\frac{3}{7}$d. Ans.

2. What was sold for £117 cost £100
∴ " " £4·9875 " £100 × $\frac{4{\cdot}9875}{117}$
i.e., $\frac{£498\ 15s.}{117}$
i.e., £4 5s. 3$\frac{1}{13}$d. Ans.

3. 31·1$\frac{1}{4}$ gui. ÷ 14$\frac{3}{5}$ = $\frac{4365 \times 5 \times 21}{14 \times 72 \times 20}$ = price of a ton.
Now what was sold for £112½ cost £100
and " " £1 " $\frac{100}{112\frac{1}{2}}$
∴ " $\frac{4365 \times 5 \times 21}{14 \times 72 \times 20}$ " $\frac{200}{225} \times \frac{4365 \times 5 \times 21}{14 \times 72 \times 20}$
i.e., $\frac{4365}{576}$
i.e., £20 4s. 2d. Ans.

4. (*a*) £3½ is got from £100 of stock
£1 " $\frac{200}{7}$ "
£3166⅔ " $\frac{200}{7} \times \frac{9500}{3}$ "
i.e., £95000 "

(*b*) And £95000 of stock is purchased for £80071 8s. 6$\frac{2}{3}$d.
" " " $\frac{80071\frac{2}{3}}{95000}$
∴ £100 " " £$\frac{80071\frac{2}{3}}{95000} \times \frac{100}{1}$
i.e., £$\frac{240}{3}$ = £84. Ans.

5. 30 sheep for 6 weeks = 180 for 1 week
20 " 10 " = 200 "
Total = 380 "
∴ A's rent = $\frac{180}{380}$ of £38 = £18; and ∴ B's = £20.
And A's profit = $\frac{180}{380}$ of £57 = £27; and ∴ B's = £30.

FEMALES.

1. $\left.\begin{array}{l}16{\cdot}125\text{ yds.} : 45\text{ yds.}\\ 1{\cdot}375\text{ " } : {\cdot}875\text{ "}\end{array}\right\}$ :: £2·2 : money required.
£2·2 × $\frac{45}{16{\cdot}125} \times \frac{{\cdot}875}{1{\cdot}375}$ = £$\frac{11}{5} \times \frac{875}{1375} \times \frac{7}{11}$
= £$\frac{140}{55}$
i.e. £3 18s. 1$\frac{5}{11}$d. Ans.

2. Suppose he lays out at the beginning £100,

Then (1) He lays out £100 and gains $\frac{20}{100}$ of it, giving £200 of cap.
" (2) " £200 " loses $\frac{20}{100}$ " leaving £160 "
" (3) " £160 " " $\frac{20}{100}$ " " £128 "
" (4) " £128 " " $\frac{20}{100}$ " " £102·4 "

But he laid out £100 at the beginning ∴ he is left with a profit £2·4 on his original outlay, and £2·4 gained on £100 must be 2·4 p.c.

3. $(2\frac{1}{2}$ of $\frac{3}{5}) \div (\frac{1}{2}$ of $3\frac{1}{3})$ of 1 ac. $= \frac{5\times3}{2\times5} \times \frac{8\times5}{5\times16}$ or $\frac{3}{4}$ ac.

$7 \times \left(\frac{7\frac{3}{13} - 4\frac{3}{13}}{\frac{1}{4} \text{ of } \frac{2\frac{1}{2}}{5}} \times \frac{\frac{2\frac{1}{2}}{5}}{\frac{2\frac{1}{2}}{5}}\right)$ of $\frac{3}{5}$ ac. $= \frac{7}{1} \times \frac{4}{13} \times \frac{13}{12} \times \frac{25}{5} \times \frac{5}{7\cdot17}$ of $\frac{3}{5}$ ac. $=$ [7] ac.

The question now stands thus—

$\frac{3}{4}$ ac. are worth £36 15s.
∴ $7\frac{1}{2}$ " " £36 15s. $\times \frac{4}{3} \times \frac{4}{3}$
i.e., £367 10s. Ans.

4. (£165 − £150) = £15 interest of £150 for 4 yrs.
= £3¾ " " 1 yr.
∴ Interest of £100 for 1 yr. = £3¾ $\times \frac{100}{150}$
= £$\frac{15\times100}{4\times150}$
i.e. £2½ p.c.

Grammar.

1. (*a*).

Sentences and Clauses.	Kind of S. or C.	Connective.	Full Subject.	Predicate.	Completion of Pred.	Extensions of Pred.
1.—As [*the matter stands*] for jest.	A kind of parenthetical, giving emphasis to *it* in (3).	As	? [the matter]	? [stands]	for jest	*there* is merely an introductory word
2.—There be certain things, namely, religion, matters of state, and any case.	Principal.		Certain things, namely, religion . . . . case.	be		
3.—Which ought to be privileged from it.	Adjectival to *things* in (2).		which	ought	to be privileged from it.	
4.—That deserveth pity.	Adject. to *case* in (2).		that	deserveth	pity (object).	

(*b*) '*That*' in the given sentence is used both as a relative and a demonstrative pronoun. As a relative it is capable of being changed into 'which,' as 'a vein which should be bridled,' as a demonstrative pronoun it is used substantively, as 'that is a vein.'

(*c*) Men's religious and political beliefs, as well as all forms of human misery, ought not to be considered proper subjects upon which to make jests. Some people, however, have a tendency to make sharp and cutting jokes that hurt men's feelings. Such an inclination should be carefully kept in check.

2. *I*—pers. pron. 1st pers., mas. or fem., sing. nom. subj. of *knew*.
knew—trans. verb, irreg. *know, knew, known* indic., past indef., 1st pers. sing. agreeing with *I*.
one—indef. pron., third pers. mas., sing. obj. gov. by *know*.
was—intrans. verb. irreg. *am, was, been*, indic. past indef. 3rd pers. agrees with subj. (*who*).
wont—complete part. from O.E. *wunian* to dwell; used only predicatively as an adjective referring to *he* in this sentence.
to say—trans. verb, irreg. *say, said, said*, infin. pres. indef. gov. by *wont*.
in—prep. gov. obj. case *scorn*.
scorn—abstr. noun, neut. sing. obj. gov. by *in*. } *in scorn* = scornfully.
he—demonstr. pers. pron. 3rd pers. sing. mas. nom. subj. of must.
must—defec. v. used only in pres. indic., forming with pres. infin.
be—3rd pers. sing., pres. pot. of the verb *to be*, agreeing with *he*.
needs—adv. (=of necessity) from an old genitive in *es* modif. *must be*.
a—indef. article generally reckoned an adj. joined to *man*.
wise—qual. adj. pos. deg. limiting *man*.
man—com. noun, mas. sing. nom. in apposition with *he*.
he—pers. pron. 3rd pers. mas., sing. referring to *man*, nom., subj. of *speaks*.
speaks—intrans. verb, irreg. *speak, spoke, (spake), spoken*, indic. pres. indef., 3rd pers. sing. agrees with subj. *he*.
so—adv. of degree mod. *much*.
much—adv. " " *speaks*.
of—prep. gov. obj. case himself.
himself—reflective pers. pron., 3rd pers. mas. sing. obj. gov. by *of*.

3. Old English differed from modern English in this respect, that it had a greater number of grammatical inflexions, that is, it made more changes in the words themselves to express changes of meaning. Thus nouns had five cases and different declensions; adjectives were declined, and had three genders; pronouns had more forms, and verbs had a greater variety of personal terminations. Modern English has dropped the greater part of these inflexions, and in their place are used prepositions and auxiliary verbs. The above explains what is meant when people say that ancient English was a more 'inflexional' language than modern English.

Geography.

1. *See same question answered under Third Year in this number of the Magazine.*

2. Immense rivers of heated waters flowing through the comparatively cool and motionless waters of the ocean are met with by seamen; while sometimes the moving stream has a much lower temperature than the rest of the sea. These are called *ocean currents*, and exist in all the great oceans.

The chief are the *equatorial currents*, flowing round the globe wherever the land allows. In the Atlantic, one of these great streams starts from St. Thomas, on the coast of Africa, and runs westward towards the shoulder of S. America. Before arriving there it throws off a branch to the south, which goes down the coast of Brazil to the lower extremity of S. America, and there turns eastward to the Cape of Good Hope. The main stream sweeps past the north coast of S. America with such strength that not even the mighty current of the Amazon can turn it aside, passes through the Windward Islands, across the Caribbean Sea, and into the Gulf of Mexico. As the current sweeps round the Gulf it becomes very hot, and is swollen by the waters of the Mississippi, till at length, under the name of the *Gulf Stream*, it forces its way into the Atlantic, between Florida and Cuba, in a stream of from thirty to forty miles wide. Its heat is from 75° to 85° Fahr. when it leaves the Gulf. At first it keeps pretty close to the coast of America, but by degrees it widens out and bears away to the east, running between Newfoundland and the Azores. Dividing there, the main body turns round the Azores, and goes off southwards to Africa. The other portion runs on northward between Great Britain and Iceland, giving warmth and moisture to Cornwall, Ireland, the Hebrides, and the Shetland Islands. This famous current has been known to carry the weeds and seeds of other lands to the coast of Norway, and even Spitzbergen. Now the northward motion of the Gulf Stream necessitates a southward motion from the Polar seas. Beneath the Gulf Stream and on the inner or land side flows a current of cold water from past Labrador to replace the warm water brought up from the tropics.

In the Pacific Ocean there is also a great equatorial current, which starts from the Bay of Panama and runs right across the ocean, past the Caroline and Ladrone islands, to the Philippines. There it is met by a current which issues from the Chinese Sea, much the same as the Gulf Stream does from the Mexican Gulf, and the two then run outside of Japan and round the north limits of the Pacific, and so down to California.

In the Indian Ocean the main current starts from the Bay of Bengal, sweeps past Ceylon and the Seychelles islands, and between Africa and Madagascar, to the Cape of Good Hope, where it is suddenly checked and turned back to the S.W.

History.

1. Our Parliament was divided into two houses probably in the reign of Edward III.

The Parliament of 1376 was called '*the Good*,' because, supported by the Black Prince, it boldly set itself to work a reformation of the evils wrought by the the men selected for the Government by the Duke of Lancaster. The Commons, among whom the *Knights of the Shire* took the chief part, impeached the Duke's friends before the Lords, charging them with frauds upon the King, and with extortion of money, and obtained their imprisonment or removal. Alice Perrers was expelled from the court on account of the evil domination which she held over Edward III.

2. *Anne Boleyn* was the first crowned queen to suffer death on the scaffold in England. The King, Henry VIII., being smitten with the charms of Jane Seymour, found a way of ridding himself of Anne by a charge of adultery. Whether the charge was true or not the marriage was declared null and void, and she was beheaded, leaving one daughter, *Elizabeth*.

3. (*a*) Henry Tudor, grandson of Catharine, widow of Henry V., and Owen Tudor, having defeated and slain the usurper, Richard III., who was the last Plantagenet king, succeeded to the throne in 1485 as Henry VII. (*b*) Queen Elizabeth having died without heirs (1603) was succeeded by James VI. of Scotland, who was the next heir in the direct line, being descended from Henry VII. through his mother, Mary Stuart, the daughter of James V., who was the son of James IV. and Margaret Tudor.

Composition.

Heat and its Uses.

Whether heat be a substance penetrating and infusing itself along all bodies, or only a quality of these bodies, to its influence are we indebted for the proper performance of all the functions of life, for all that our eyes see and that our ears delight in, as well as for everything that gratifies the taste. We not only depend on the heat itself, but we require to have it in due proportions, because either too much or too little of it is alike injurious, and even fatal, to both animal and vegetable life.

To distinguish the sensation of heat from heat itself, and prevent the confusion arising from interchange of terms meaning sometimes one thing and sometimes another, the term *caloric* has been employed to denote that which causes the production of heat. We often hear the terms *heat* and *cold* used in everyday life, the latter being employed to mean an agent directly opposed to the former, but, strictly speaking, cold is only the absence of heat. We all know by experience that the gradual loss of heat gives us the feeling of cold, but this is only a relative term, since there is no body entirely destitute of heat, though there may be less heat in one substance than another. Seeing that our sensation of heat is very defective as a heat measurer, an instrument called a *thermometer* is used to detect the quantity of heat in any substance. By means of this instrument we are able to compare bodies as to the quantity of heat in each, the one having more heat being said to have a higher *temperature* than that which has less. Heat is imparted from one body to another in two ways, by *radiation* and by *conduction*. If we place ourselves before a fire we feel the heat darting towards us in rays, as it were—this is an example of *radiation*; and if we place a bar of iron in the fire we can feel the part projecting gradually getting warmer, although not in actual contact with the coals, the heat in this instance being led or conducted along the particles of the metal, and this gives us an illustration of *conduction*. From the fact that some materials are good conductors, and some *bad*, or *non*-conductors, attention to this gives us a guide in the selection of clothing and building materials to suit different climates.

Euclid.

1. Prop. 3, Bk. II. This proposition may be represented algebraically thus:—Let the whole line contain a linear units—one part contain m and the other n linear units. Then $a = m + n$. Multiply these units by m $\therefore ma = m^2 + mn$. That is, if a number be divided into two parts, the product of the whole number and one of the parts is equal to the square of that part, together with the product of the two parts.

2. Prop. 12, Bk. II.

Let ABCD be a parallelogram, whose diagonals AC, BD are equal, then its angles shall be right angles. Because the diagonals of a parallelogram bisect each other, then AC, BD are bisected in E. Then, because EB=EC, the angle EBC=angle ECB (i. 5). For the same reason the angles ECD, EDC are equal. Therefore the whole angle BCD is equal to the two angles CBD, BDC—that is, BCD is=to the half of two right angles. It is therefore a right angle, and BC is parallel to AD, and the two interior angles, ADC, DCB are equal to two right angles; but DCB was shown to be a right angle, therefore ADC is a right angle. And since the opposite angles of a parallelogram are equal to one another, then each of the angles of the figure ABCD is a right angle.—Q. E. D.

Algebra.

1. The proof of the rule for finding the G. C. M. depends on the following principles:—

(*a*) If D divide A, then it will divide mA. For since D divides A, we may suppose A=aD, then mA = maD; thus D divides mA.

(*b*) If D divide A and B it will divide mA$\pm n$B. For since D divides A and B, we may suppose A=aD, and B = bD, then mA$\pm n$B = (mA$\pm n$B) D; thus D divides mA$\pm n$B.

Let A and B denote the two algebraical expressions, and let them be arranged according to descending powers of some common letter, and suppose the index of the highest power of that letter in A not less than the index of the same letter in B. Divide A by B; let p denote the quotient, and C the remainder. Divide B by C; let q denote the quotient and D the remainder. Divide C by D, and suppose that there is no remainder, and let r denote the quotient. Thus we have the following results:—

B) A (p
pB
C) B (q
qC
D) C (r
rD

$$A = pB + C;\ B = qC + D;\ C = rD.$$

Now, D divides C since C=rD; hence by principle (*a*) D also divides qC, and also qC+D; that is, D divides B. Again, since D divides B and C, it divides pB+C; that is, D divides A. Hence, since D divides A and B, it is a common measure of them. D is not only *a* common measure, but *the* greatest common measure.

By principle (*b*) given above, every expression which divides A and B divides A$-p$B, that is, C; thus every expression which is a measure of A and B is a measure of B and C. Similarly every expression which is a measure of B and C is a measure of C and D. Thus every expression which is a measure of A and B divides D. But no expression higher than D can divide D. Thus D is the G. C. M.

2. (1) (*a*)
$2(x+y) = 3(x-y) + 10$
$2x + 2y = 3x - 3y + 10$
$-x + 5y = 10$
$-2x + 10y = 20$

(*b*)
$2x - y = 4(2y - x) + 3$
$2x - y = 8y - 4x + 3$
$6x - 9y = 3$
$2x - 3y = 1$

From (*a*) $-2x + 10y = 20$
By adding ... $7y = 21$
$y = 3$

By substitution $-x + 15 = 10$ or $-x = 10 - 15$ $\therefore x = 5$

(2) $$\frac{x+2}{x-1} - \frac{4-x}{2x} = \frac{7}{2}.$$

Clearing of fractions—
$$6x^2 + 12x - 15x + 3x^2 + 12 = 14x^2 - 14x$$
Collecting ... $5x^2 - 11x = 12$
Dividing by 5 $x^2 - 2\frac{1}{5}x = 2\frac{2}{5}$

Completing the square $x^2 - 2\frac{1}{5}x + 1\frac{21}{100} = \frac{240 + 121}{100} = 3\frac{61}{100}$.

Taking the root, $x - 1\frac{1}{10} = \pm 1\frac{9}{10}$
$x = 1\frac{1}{10} \pm 1\frac{9}{10} = 3$ or $-1\frac{4}{5}$ Ans.

3. Let x = the unit's, and y = the ten's figure.
(1) then the no. = $10y + x = 7x$.
(2) But if $10x + y$ be the order of the digits, then $10x + y = 7x + 18$ from (1) $10y = 6x$.

$y = \frac{7}{5}x$ ∴ substituting $\frac{7}{5}x$ for y in (2)

$$10x + \tfrac{7}{5}x = 7x + 18$$
$$50x + 7x = 35x + 90$$
$$18x = 90$$
$$x = 5$$

Hence the no. = $7 \times 5 = 35$. Ans.

Mensuration.

1. Area of equilateral triangle = $25^2 \times \cdot 433$ (which is the approximate area of an equilateral triangle, whose side is 1.) = $625 \times \cdot 433$

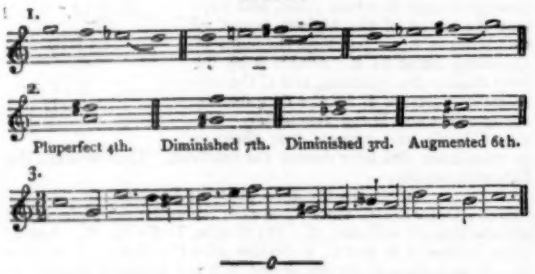
$$\begin{array}{r} \cdot 433 \\ 1875 \\ 1875 \\ 2500 \\ \hline 270 \cdot 625 \end{array}$$

sq. ft. Ans.

2. Diameter of outer circle = 26·7 ft.
„ inner „ = 20·3 „
And the required area = sum of diars. × by their diff. × ·7854
= $47 \times 6 \cdot 4 \times \cdot 7854$

$$\begin{array}{r} 6 \cdot 4 \\ \hline 188 \\ 282 \\ \hline 300 \cdot 8 \\ \cdot 7854 \\ \hline 1203 \cdot 2 \\ 15040 \\ 24064 \\ 21056 \\ \hline 236 \cdot 2483 \cdot 2 \end{array}$$

sq. ft. Ans.

Music.

☞ As it is probable that 'Proportion' will henceforth have to be worked by the 'Unitary Method,' we have pleasure in acceding to the request of several correspondents to give a short description of that method.

The Unitary Method in Proportion.

BY W. P. WORKMAN, TRINITY COLLEGE, CAMBRIDGE.

IT is our purpose in the following paper to give an account of one of the greatest simplifications which has been effected in modern arithmetic. All of us have, at some time or other, been subjected to the domination of that imperious and arbitrary Rule of Three, and there can be but few who will not be glad to escape from it. Of the advantages of a new method we shall leave the numerous appended examples to silently testify, only stating that the introduction of this method is in accordance with the important canon by which alone every mathematical improvement must be tested before it can be accepted. That is—while not attempting to elucidate any new facts, it clears up old ones, and at the same time does not increase the number of things to be remembered, or the number of principles to be applied.

It is almost impossible to formulate the Unitary System in words, for when we attempt to do so we arrive at nothing but self-evident axioms. It amounts to the following rule :—

Given the unit we may find the value of any number of units by multiplication, or the number of units amounting to any given value, by division. Thus if one copy of a book weigh 6 ounces, a thousand copies will weigh 6,000 ounces. It is perhaps possible that the uninitiated will affirm that the rule as it stands is not more intelligible than the mysterious rows of dots in the Rule of Three, while the example is, and always has been, a truism. Let us, then, first put the example in algebra—

If a things cost £x
ab „ £bx.

Now we may proceed to point out that this simple process is really all that is necessary for working out examples in Simple or Double Proportion. For instance :—

If $\frac{7}{8}$ of a vessel cost £770, what is the value of $\frac{3}{4}$ of it?

The old method was to write down the result thus :

$\frac{7}{8} : \frac{3}{4} :: 770 :$ value in pounds.

$$\therefore \text{value} = £\frac{\frac{3}{4} \times 770}{\frac{7}{8}} \text{ or } £660.$$

Undoubtedly this is short enough, but not one scholar in ten understands it when he applies it. Now observe the rational common-sense Method of Unity.

$\frac{7}{8}$ cost £770.
$\therefore \frac{1}{8}$ „ £110.
$\therefore 1$ „ £880.
$\therefore \frac{1}{4}$ „ £220.
$\therefore \frac{3}{4}$ „ £660.

At first sight this seems longer; but remembering that of the four steps not more than two at the utmost would be necessary—for the first two and last two could be compressed into one each—remembering also that every one of the four steps is logical and straightforward, and that an accomplished worker can easily write down the answer—in a complex form, of course—to any sum, however involved, in Simple *or* Compound Proportion, the objections would vanish.

Double Rule of Three, or, as we have called it, Compound Proportion, is the one bugbear in arithmetic which children uniformly detest. If taught to look at it from our standpoint, we believe that all their objections to it will ultimately vanish. We will give an example in both methods.

Ex. If 27 yds. of cloth, $\frac{3}{4}$ yds. wide, cost £20, what must be given for 36 yds. of cloth $\frac{1}{2}$ yd. wide?

Old Method.—If the 36 yds. were of same width as 27 yds., cost would be found from equation.

27 : 36 :: £20 : cost

or cost = £$26\frac{2}{3}$. Thus our question reduces itself to

If 36 yards, $\frac{3}{4}$ yd. wide, cost £$26\frac{2}{3}$, what will same number of yards cost when cloth is $\frac{1}{2}$ yd. wide?

This we find thus :

$\frac{3}{4}$ yard : $\frac{1}{2}$ yard :: £$26\frac{2}{3}$: cost
∴ cost = £17 15s. $6\frac{2}{3}$d.

New Method.—In this particular example we should first rewrite it thus :—

If cloth of the area of $27 \times \frac{3}{4}$ sq. yds. cost £20, what will be given for an area of $36 \times \frac{1}{2}$ yds?

Now $27 \times \frac{3}{4}$ cost £20

$$\therefore \text{1 costs } £\frac{20 \times 4}{81}$$

$$\therefore 36 \times \tfrac{1}{2} \text{ cost } £\frac{20 \times 4 \times 18^{2}}{81}$$

$$9$$

$$\text{or } £\frac{160}{9}$$

The only rule which can fairly be called a rule at all, is one rather of expediency than necessity. It is advisable to keep the unknown quantity until *the end of the original statement* of the problem. An example will illustrate our meaning :—

If 200 *men can in* 25 *days make an embankment* 5 *miles long, how much overtime must* 60 *men work in order to finish an embankment* 2 *miles long in* 32 *days,* 12 *hours being a day's work ?*

Here the unknown quantity is time, and we state the date as follows, putting time last—

200 men do 5 miles in 25 days.
1 man does „ 25 × 200 days.
1 man does 1 mile in 1000 days.
60 men do 1 mile in $\frac{1000}{6}$ days.
60 men do 2 miles in $\frac{1000}{3}$ days.

But we are told that they do it in 32 days

$\therefore$ Their days must be $\frac{100}{3 \times 32}$ of the first men's days

i.e.—They are $\frac{100}{3 \times 32} \times 12$ hours

or $12\frac{1}{2}$ hours

$\therefore$ They must work $\frac{1}{2}$ hour overtime.

As another example take :—

Assume that 6 *men can do as much work in an hour as seven women, and* 8 *women as much as* 11 *boys, and that* 5 *men can do a certain piece of work in* 10 *hours. How long will it take* 1 *man,* 2 *women, and* 3 *boys together, to do the same piece of work ?*

5 men do work in 10 hours.
1 man does work in 50 hours (a common mistake is to write 2 hours here.)
$\therefore$ 1 man does $\frac{1}{50}$ of work in an hour.
7 women do as much as 6 men.
$\therefore$ 1 woman does $\frac{6}{7}$ as much as a man.
$\therefore$ 1 woman does $\frac{3}{175}$ of work in an hour.
11 boys do as much as 8 women.
$\therefore$ 1 boy does as much as $\frac{8}{11}$ women.
$\therefore$ 1 boy does $\frac{8}{11} \times \frac{3}{175}$ of work in an hour.
$\therefore$ when 1 man, 2 women, and 3 boys are at work, their combined efforts accomplish

$$\left\{ \frac{1}{50} + 2 \times \frac{3}{175} + 3 \times \frac{8}{11} \times \frac{3}{175} \right\} \text{ of work in an hour.}$$

i.e.—$\frac{353}{3850}$.

Hence they will do the whole work in $\frac{3850}{353}$ hours, or 10 $\frac{320}{353}$ hours.

It is unnecessary to add further example. The method is of use where ordinary Rule of Three is either cumbrous or unmeaning, and is capable of being applied to all the cases to which the original rule was applicable. It will therefore be useful in stocks, interest, etc., etc.

In conclusion, we advise every one to whom the method is new to take his arithmetic and work out a hundred examples by it. As an additional help he will find examples illustrative of the method, worked out on the following pages of the PRACTICAL TEACHER :—207, 254 (2 examples), 308, 309, 310, 345, 406, and 461.

Scholarship Examination, 1881.

FEMALE CANDIDATES.

Arithmetic.

Three hours allowed for this paper.

Candidates are not permitted to answer more than *one* Question in each Section.

The *solution* must in every instance be given at such length as to be intelligible to the Examiner, otherwise the answer will be considered of no value.

SECTION I.

1. The circumference of the earth is, in round numbers, 25,000 miles ; how many feet does it contain ?

2. Add together 4 tons 17 cwt. 3 qrs. 18 lbs. ; 2 tons 3 cwt. 3 qrs. 15 lbs. ; 13 tons 9 cwt. 2 qrs. 25 lbs. ; and 22 tons 18 cwt. 3 qrs. 19 lbs. ; and divide the result by 133.

SECTION II.

1. Find the value of 733½ articles at £2 18s. 6d. each ; and of 751½ at £1 8s. 11d. each ; and subtract the less from the greater.

2. If sugar be bought at £1 19s. 6d. per cwt., and retailed at 6½d. per lb., what is the profit on a cask containing 7 cwt. 1 qr. 14 lbs. ?

SECTION III.

1. A householder paid the following bill with a five-pound note : what change did he receive ?—
   3½ cwt. of coals at 10½d. per cwt.
   13 lbs. of cheese at 7½d. per lb.
   2¾ lbs. of tea at 3s. 3d. per lb.
   17 lbs. of sugar at 5½d. per lb.
   8½ yards of flannel at 1s. 11½d. per yard.
   29 yards of calico at 10¾d. per yard.

2. A lady paid with 3 ten-pound notes for—
   64 yards of sheeting at 14½d. per yard.
   4 pairs of blankets at 18s. 4d. per pair.
   3 pairs of blankets at 12s. per pair.
   18½ yards of silk at 5s. 6d. per yard.
   26 yards of huckaback at 10½d. per yard.
   9 damask table cloths, 4 of them at 19s. 6d. each, and the remainder at £1 6s. 6d. each.
   4 balls of string at 1s. 6d. for a dozen balls.

What change should she have received, the tradesman allowing a guinea and a half discount on the whole for cash ?

SECTION IV.

1. Find, by Practice, the value of 3 qrs. 5 lbs. 9 ozs. at £2 14s. 6d. per lb.

2. Find, by Practice, the amount of a rate of 13s. 4½d. in the £ on £1,710 16s. 8d.

SECTION V.

1. If the poor-rate on a house rated at 60 gs. be £2 8s. 6¾d, what amount of poor-rate ought to be paid on a farm rated at £1,904 ?

2. A farmer sold five lots of rye, each containing 34 bushels 2½ pecks, for £40 7s. 11d. How much ought 100 quarters of the same rye to fetch at that rate ?

SECTION VI.

1. If 24 lbs. of wool make 115 yards of cloth 1 yard wide, how much cloth 1¼ yards wide ought 12 ozs. to make ?

2. If the wages of 13 men for 7¼ days amount to £13 7s. 0½d, how many men ought to work for 24 days for £173 8s. ?

SECTION VII.

1. Which is the greater, and by how much, of the following quantities—1⅜ of 1 ton 11 lbs. ; or 3⅝ of 11 cwt. 6 lbs. ?

2. A lady having spent ⅓ of her money in one shop and ¼ of it in another, had left £3 17s. What sum had she to start with, and what decimal of that sum is the amount which she had left ?

SECTION VIII.

1. Find the value of ·4⅝ of £1 13s., and convert into vulgar fractions 2·34⅝, and ·52̇2̇0̇.

2. How many oranges at £·084375 per dozen ought to be given in exchange for 378 eggs at ·0,625s. each ?

SECTION IX.

1. In what time will £56 5s. amount to £64 2s. 6d., at 3½ per cent. per annum, simple interest?

2. A confectioner gained 60 per cent. by selling sugar candy at 1½d. per oz.; what per cent. would he have gained or lost by selling it at 8d. a lb.?

ANSWERS.—SCHOLARSHIP EXAMINATION.

FEMALE CANDIDATES.

Arithmetic.

SECTION I.

1. No. of feet = 25000 × 1760 × 3

4 | 176000

44000000

3

Ans. 132,000,000

2.

Tons.	cwt.	qrs.	lbs.
4	17	3	18
2	3	3	15
13	9	2	25
22	18	3	19

133)43 10 1 21(

20

870(6 cwt.

798

72

4

289(2 qrs.

266

23

28

184

46

21

665(5 lbs.

665

Ans. 6 cwt. 2 qrs. 5 lbs.

SECTION II.

1.

	£	s.	d.		£	s.	d.
733½ at	2	18	6 × 3	751½ at	1	8	11
			10				10
	29	5	0 × 3		14	9	2
			10				10
	292	10	0		144	11	8 × ½
			7				7
	2047	10	0		1012	1	8
	87	15	0		72	5	10
	8	15	6		1	8	11
	0	14	7½		0	14	5½
	2144	15	1½		£1086	10	10½
	1086	10	10½				
Ans.	£1058	4	3				

2. 6½d. per lb. is 6½d. × 112 per cwt.

i.e., 728d. per cwt.

i.e., £3 0 8 per cwt.

1 19 6

Profit per cwt. is £1 1 2

Hence we have to find the value of 7 cwt. 1 qr. 14 lbs. at £1 1s. 2d.

	£	s.	d.
	1	1	2
			7
	7	8	2
1 qr. = ¼ cwt.	0	5	3½
14 lbs. = ½ qr.	0	2	7½
	£8	4	1½

SECTION III.

1.

		s.	d.		£	s.	d.
3¼ cwt. of coals	at	0	10½	is	0	3	0¾
13 lbs. „ cheese	„	0	7½	„	0	8	4¾
2¾ lbs. „ tea	„	3	3	„	0	8	11¼
17 lbs. „ sugar	„	0	5½	„	0	7	9½
8½ yds. „ flannel	„	1	11½	„	0	16	7¾
29 yds. „ calico	„	0	10¾	„	1	5	11¼
					3	10	9¼
Money paid					5	0	0
Change required					£1	9	2¾

2.

		£	s.	d.		£	s.	d.
64 yds. sheeting	at	0	1	2½	is	3	17	4
4 prs. blankets	„	0	18	4	„	3	13	4
3 „	„	0	12	0	„	1	16	0
18½ yds. silk	„	0	5	6	„	5	1	9
26 yds. huckaback	„	0	0	10¾	„	1	3	3½
4 cloths	„	0	19	6	„	3	18	0
5 „	„	1	6	6	„	6	12	6
½ doz. string	„	0	1	6	„	0	0	6
						26	2	8½
Discount						1	11	6
						24	11	2½
Money paid						30	0	0
Change required						£5	8	9½

SECTION IV.

1.

	£	s.	d.	
89 lbs. 9 oz. at	2	14	6	× 9
			10	
	27	5	0	
			8	
	218	0	0	
	24	10	6	
8 oz. = ½	1	7	3	
1 oz. = ⅛	0	3	4⅞	
	£244	1	1⅞	

2. 13s. 4d. is £⅔ ∴ 13s. 4d. in £ is ⅔ of rateable sum.

	£	s.	d.	£	s.	d.
13s. 4d. on 1710 16 8 is				1140	11	1½
½d. in £ on 1710 16 8 „				3	11	3$\frac{5}{12}$
Value of rate				£1144	2	4⅚

The last item is calculated thus:—

½d. in £ on £1710⅔ is ½d. in 1d. on 1710⅔d.

i.e., is ½ (1710⅔)d., *i.e.*, 855$\frac{1}{12}$.

SECTION V.

1.

	£	s.	d.
Poor rate on £63 is	2	8	6¾
£7 „	0	5	4¾

	£	s.	d.
£1904 is 272 ×	0	5	4¾
			8
	2	3	2
			34
Ans.	£73	7	8

2. 5 lots go for £40 7s. 11d.

1 lot goes for £8 1s. 7d.

34⅛ bushels for £8 1s. 7d.

$2\frac{17}{20}$ bushels for £$\frac{1 \times 8}{34}$

1 bushel for £$\frac{1}{34}$

1 quarter for $\frac{8 \times 7}{30}$

100 quarters for £$\frac{8 \times 7 \times 100}{30}$ *i.e.*, £186 13s. 4d.

SECTION VI.

1. 2¼ lbs. of wool make 115 sq. yds. of cloth.

12 oz. „ $\frac{1}{3}$ × 115 sq. yds.

But the cloth is 1¼ wide

∴ it is $\frac{4}{5} \times \frac{1}{1\frac{1}{4}} \times 115 = 23$ yds. long.

Ans. 2 yds. 2 ft. 7½ in.

2.

			£	s.	d.
13 men in	7½ days	get	13	7	0½
1 man in	7½ ,,	gets	1	0	6½
1 ,,	29 ,,		4	2	2
1 ,,	1 ,,		0	2	10
1 ,,	24 ,,		3	8	0

∴ No. of men is $\frac{2}{4}\frac{4}{8}$ or 51.

SECTION VII.

1. $1\frac{5}{8}$ of 1 ton 11 lbs.

		ton	cwt.	lbs.
1	=	1	0	11
		5	0	55
$\frac{5}{8}$	=	0	11	$18\frac{3}{8}$
$1\frac{5}{8}$	=	1	11	$29\frac{3}{8}$

		cwt.	lbs.
$3\frac{3}{4}$	of	11	6
			3
		33	18
2		22	12
$\frac{3}{4}$		4	$47\frac{1}{4}$
		37	$65\frac{1}{4}$
		31	$29\frac{3}{8}$
Second is greater by		6	$35\frac{7}{8}$

6 cwt. 1 qr. $7\frac{7}{8}$ lbs.

2. She evidently had $(1 - \frac{1}{2} - \frac{1}{4})$ of her money left, *i.e.*, $\frac{1}{4}$.

∴ $\frac{1}{4}$ of her money is £3 17s.
∴ her money is £7
£3 17s. is $\frac{1}{4}$ of £7, *i.e.*, $\frac{5}{1}\frac{5}{0}\frac{5}{0}$ or ·55.

SECTION VIII.

1. $\cdot 4\dot{5} = \frac{4}{8}\frac{5}{8} = \frac{5}{11}$.
$\frac{5}{11}$ of £1 13s. is 5 × 3s., *i.e.*, 15s.

$2\cdot 34\dot{5} = 2\frac{3}{8}\frac{8}{8} = 2\frac{3}{11}\frac{5}{0} = 2\frac{1}{2}\frac{5}{2}$
$\cdot 52\dot{6} = \frac{5}{9}\frac{2}{9}\frac{6}{9} = \frac{1}{1}\frac{2}{7}\frac{3}{3}$

2. 378 eggs at ·0625s. each
at ·7500d. each
i.e., at ¾d. each
are $\frac{2}{3}\frac{8}{4}$d.
£·084375 = 20·25d. = 20¼d.
20¼d. is contained in $\frac{2}{3}\frac{8}{4}$d. 14 times.
∴ the answer is, 14 doz. oranges.

SECTION IX.

1. Working sum backwards,

£	s.	d.	
64	2	6	amount.
56	5	0	principal.
£7	17	6	interest.

Obviously number of years $= \frac{£7\ 17s.\ 6d. \times 100}{3\frac{1}{2} \times £56\ 5s.} = 4$

2. 1¼d. per oz. is 20d. per lb. He gains 60% ∴ selling price is $\frac{1}{2}\frac{8}{0}$ or ⅘ of buying price. ∴ value of candy is ⅘ × 20 = 16d. per lb. *i.e.*, 12½d.
If, therefore, he sells at 8d.,
on every 12½ he loses 4½
" 100 " 8 × 4½ or 36.
Ans. Loss of 36 %.

(N.B.—If, in looking through this work, any reader detects an error, we shall be glad to be apprised of it. Through press of time, the whole has had to be put together in an hour or two.)

—o—

Publications Received.

Astronomy—

(1) Browne's Astral Origin of Hebrew Emblems. E. Stanford.

Composition—

(1) Wood's Analytic Test Exercises and Examples. J. Marshall and Co.

Domestic Economy—

(1) Floyer's Needle Drill, Position Drill, and Knitting-Pin Drill. Griffith and Farran.

English Literature—

(1) Poetry for the Young. Part I. Griffith and Farran.

Geometry—

(1) Walmsley's Introduction to Geometry. Hodgson and Son.

Latin—

(1) Dodd's Matriculation Latin. W. Stewart and Co.
(2) Gibson's Limen Latinum. Relfe Bros.

Mathematics—

(1) Langton's Examples in Arithmetic. Standards V. and VI. T. Murby.
(2) Sparke's Inductive Algebra. W. Stewart and Co.

Miscellaneous—

(1) Clifford's What Her Majesty's Inspectors Say. North of England School Furnishing Company.
(2) Story's School Board Gymnastics. L. N. Fowler.
(3) Kiddle and Schem's Dictionary of Education and Instruction. Sampson Low and Co.

Mechanics—

(1) Watt's Mechanical Industries Explained. W. and A. K. Johnston.

Music—

(1) McCartney's Selections from the Poets set to Music. R. J. Derfel.
(2) McCartney's Musical Drill. G. Gill and Son.

Periodical Literature—

(1) Ward and Lock's Universal Instructor, XIII. Ward, Lock, and Co.
(2) Our Little Ones. Vol. II. No. 1. Griffith and Farran.

Prize Books—

(1) Our Little Ones. Griffith and Farran.
(2) Holly Berries. Griffith and Farran.
(3) Kingston's Peter the Whaler. Griffith and Farran.
(4) Ludgate Hill, Past and Present. Griffith and Farran.
(5) Knight's Rocket. Nelson and Sons.
(6) Schwatka's Search for Franklin. Nelson and Sons.
(7) Hoare's Tempered Steel. Nelson and Sons.
(8) Geddie's Beyond the Himalayas. Nelson and Sons.
(9) Alpine Climbing. Nelson and Sons.
(10) Wilson's Great Heights. Nelson and Sons.
(11) Surr's Stories about Dogs. Nelson and Sons.

Scripture—

(1) Ottley's Church Teaching for Sunday Schools. National Society.
(2) Benham's How to Teach the Old Testament. National Society.
(3) Yonge's How to Teach the New Testament. National Society.
(4) Yonge's Practical Work in Sunday Schools. National Society.

School Management—

(1) Prince's School Management and Method. J. Heywood.

Science—

(1) Stoker and Hooper's Matriculation Chemistry. W. Stewart and Co.
(2) Gardiner's Acoustics, Light and Heat. J. Heywood.

Theology—

(1) Thomas's Synopsis of Butler's Analogy of Religion. T. Murby.

Writing—

(1) Tidmarsh's Modern Copy Books. Longmans, Green and Co.

Recent Inspection Questions.

[The Editor respectfully solicits contributions—all of which will be regarded as STRICTLY PRIVATE*—to this column. For obvious reasons, it cannot be stated in which district the questions have been set.]*

Arithmetic.

STANDARD I.

(1) From two hundred and one, take one hundred and ninety-eight. Ans. 3.

(2) Add together,—five hundred and nineteen, eight, six hundred and twenty, seven hundred and thirty-eight, and three hundred and fifty-one. Ans. 2,236.

(3) From eight hundred and fifty, take six hundred and thirty. Ans. 220.

(4) Add together,—eight hundred and ninety, two hundred and six, fifty-seven, one hundred and twelve, and six hundred and ten. Ans. 1875.

STANDARD II.

(1) From eighty thousand and thirty-seven, take thirteen thousand eight hundred and ten. Ans. 66,227.

(2) Divide fifty thousand and fifty-two by twelve. Ans. 4,171.

(3) Multiply five thousand three hundred and sixty-four by five hundred and forty. Ans. 2,896,560.

STANDARD III.

(1) Add together,—sixty-three thousand and seventy-one pounds fifteen shillings and eightpence farthing, forty thousand and nine pounds and elevenpence three farthings, four hundred thousand and eleven pounds nineteen shillings and sevenpence farthing, fifty pounds twelve shillings and ninepence halfpenny, and seven hundred thousand four hundred and thirty-two pounds eleven shillings and a penny three farthings. Ans. £1,203,576 0s. 2¼d.

(2) Find the difference between one hundred thousand one hundred pounds one shilling and sevenpence, and ninety thousand six hundred and one pounds eleven shillings and fourpence halfpenny. Ans. £9,498 10s. 2¼d.

(3) Divide four hundred and forty-seven thousand eight hundred and fifty, by seventy-four. Ans. 6,052—2.

STANDARD IV.

(1) How many minutes has a boy lived who is 12 years old? (Do not neglect leap years). Ans. 6,311,520.

(2) Divide two million and twenty thousand and twenty pounds one shilling and one penny by one hundred and sixty-four. Ans. £12,317 3s. 10¾d.—104 remain.

(3) Multiply £480 19s 7½d. by 1,706. Ans. £820,554 0s. 3d.

STANDARD V.

(1) How much change should you get if you gave a £10-note in payment of the following bill—56 table books @ 4 for 6d., 8 doz. geographies @ 2½d. each, 3,750 pencils @ 9s. 6d. per 1,000, 72 rulers @ 1s. 4½d. per doz., 26 atlases at 4s. 3d. each. Ans. 18s. 7½d.

(2) Find the cost of 13 cwt. 2 qrs. 21 lbs. @ £5 18s. 6d. per cwt. Ans. £81 1s. 11⅝d.

(3) If 113 tons of coal cost £119 14s., what should be the cost of 19 tons? Ans. £20 2s. $6\frac{42}{113}$d.

(4) A man bought 744 oranges @ 9d. per doz., at how much each must he sell them so as to gain 15s. 6d.? Ans. 1d each.

STANDARD VI.

(1) Find the value of $\frac{(2 + \frac{1}{6}) \div 3\frac{1}{2}}{\frac{1}{2} - (\frac{1}{3} \text{ of } \frac{1}{4})}$ Ans. $2\frac{2}{65}$.

(2) Take ·125 of 10s. from ·375 of 13s. 4d. Ans. 3s. 9d.

(3) If 14 horses can be kept 10 days for £15, how many can be kept 21 days for £18? Ans. 8 horses.

(4) After 9 gallons have been drawn off from a cask it is ⅔ full. How many gallons can it hold? Ans. 15 gallons.

Dictation and Grammar.

STANDARD II.

Dictation.—A fire on land is a terrible thing, but a fire at sea is much more terrible. On land we may, perhaps, get out of its way, but at sea there is often no chance of escape.

Grammar.—Underline the nouns in the above.

STANDARD III.

Dictation.—Sometimes the tiger, when hunted, springs upon the elephant and fastens his teeth and claws in his neck or shoulder. The latter tries to kneel on his enemy, so as to crush him by the weight of his great legs and heavy body. Sometimes they both roll on the ground, and a fearful struggle follows, generally, however, ending in the death of the tiger, either from the strength of the elephant, or by a bullet from the hunter's rifle.

Grammar.—Write out a list of nouns and verbs in the above.

STANDARD IV.

Dictation.—It was a perilous undertaking, yet he must obey; and the men began their terrible march, through narrow defiles, past overhanging precipices, six thousand feet up, up, up, among the gloomy solitudes of the Alps. The cannon were placed on rough sleds, each drawn by a long team of soldiers, or, when the roads permitted, by oxen, and the ammunition was packed on mules.

Grammar.—Name the parts of speech in the following passage:—All hands were soon on deck, looking at it, and admiring in various ways its beauty and grandeur.

STANDARDS V. AND VI.

Grammar.—Parse and analyze:—

(A) Well had the boding tremblers learnt to trace
The day's disasters in his morning face.

(B) Full well they laughed with counterfeited glee
At all his jokes, for many a joke had he.

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*** *We regret that, owing to the great pressure upon our space, the 'Monthly Notes' and 'Gossip' are again crowded out.*

We learn that the next Examination for Certificates will be held at the London Institute for the Advancement of Plain Needlework, 2, Connaught Street, Edgware Road, on Saturday, December 10th, 1881, at 11 a.m. Persons desirous of being examined are requested to apply to the Principal, at above address.

***

We hear that the North of England School Furnishing Company, Limited, of Darlington and Newcastle-on-Tyne, have purchased the goodwill, patents, etc., of the firm of Colman and Glendenning, of Norwich. The services of Mr. John Glendenning have been also retained by the Company.

Publications Reviewed.

*** **We are sorry to disappoint the many friends who desire us to quote the price of each work noticed in our columns. This we would respectfully point out is the publishers' duty and not ours; we give publicity enough to a book when we review it. Our readers should peruse the advertisements in our pages, and failing to find the price here, it would be no great trouble or expense to drop a line to the publishers whose name and address we will gladly give.**

Lectures on Teaching. By J. G. Fitch, M.A. Cr. 8vo, 436 pp. London: Cambridge Warehouse, 17, Paternoster Row.

SECOND NOTICE.

On Writing we need say little. As one of Her Majesty's Inspectors, Mr. Fitch asserts: 'There are, in fact, no bad writers in an elementary school of the best class,' and he shows that 'a good method steadfastly carried out is infallibly efficacious even in the worst cases,' in securing a good handwriting.

The difficulties of teaching 'Reading' and Spelling on account of the anomalies of our so-called orthography, are discussed at length and to good effect. But, while these are familiar to all teachers, the methods for overcoming them are not so well known. Reading is largely a mechanical process, and, therefore, may be greatly assisted by appliances. 'A good reading-book,' says Mr. Fitch, 'should (1) be well printed in sufficiently large type to make it very easy for the child to put his finger to each word as he pronounces it. (2.) It should be made attractive by pictures, and by the pleasantness and interest of the subject. This is of first importance. (3.) The lessons should not be graduated by so mechanical a rule as the mere length of the words and the number of syllables... (4.) Many of the lessons should be narrative and in the form of dialogue, giving some play for changes of voice... (5.) Every lesson should contain, at least, two or three words which are a little beyond the child's own vocabulary... One of the first objects of a reading lesson is to enrich the scholar's store of words.'

These remarks are quoted for the benefit of young teachers, who are almost bewildered by the number of the reading-books brought under their notice. Mr. Fitch is, we believe, a safe guide in such an important matter. He insists that anomalous words should not occur in early lessons, and that the 'real gradation' depends 'on the number of anomalies' in the words introduced.

The proper mode of using such a 'good book' both for reading and spelling is given in instructive detail. The author says further on: 'Spelling is a matter for the eye, not for the ear;' and 'the person who spells well is he who carries in his memory a good visual impression of the picture of the word.' We are therefore surprised to read (p. 213) as an 'obvious truth,' 'that it is mainly by writing that spelling is to be taught.' The Dictation exercise we think is only a *test* of ability to reproduce 'the picture of the word.' Spelling was never *taught* by dictation.

Mr. Fitch's summary of rules for 'expressive reading' are valuable, as are also the suggestions on the use of

words in 'oral expression,' or, as we might call it, *viva voce* composition (p. 219). So much of a child's school life is commonly spent in learning to read and write, that every 'practical teacher' will avail himself of any hint which tends to the more rapid and effective acquisition of these 'instruments of sense-training.' Many such hints are given in this lecture.

Having discussed the value of linguistic studies generally, the author maintains in the ninth chapter that the study of our own tongue deserves more respectful treatment than it receives even in our higher schools, and points out that when no other language is taught it is an indispensable educational instrument. The value of rules to teach the 'art of speaking and writing the English language with propriety' is shown to be practically *nil;* and though Mr. Fitch seems not to be aware that such faults as, 'Give I the book,' 'Send the money to he,' do exist in the vernacular of the West, all will allow that 'speaking with propriety' results from imitation and habit, and not from the rules of grammar. Yet if 'English Grammar' be made to include 'the logic, history, formation, and relation of words, it will designate one of the most fruitful and interesting of school studies.' Mr. Fitch insists on the application of the analytical method to a vernacular language, and gives a series of suggestive illustrations. 'One essential object contemplated in the study of our own language is a knowledge of the meanings of its words.' This is 'closely connected with grammar,' and practice in the use of words in various combinations in oral or written composition is, in our opinion, of the greatest value to all. In the case of those children who, as in most of our primary schools, do not remain at school long enough to study much grammar, this mode of acquiring an enlarged and exact vocabulary must be far more useful than the parsing exercises on which they vainly spend so much precious time. An example of one convenient mode of writing out the analysis of sentences is given at length, and this lecture concludes with some directions as to the study of literary masterpieces and as to the means of imparting an enthusiastic love of reading which should be the chief purpose of lessons in English literature.

A History of the British Empire. By E. Sanderson, M.A. London: Blackie and Son, Old Bailey.

This book of nearly 450 closely yet remarkably well-printed pages contains an immense accumulation of facts, together with forty-eight columns of names with dates, and also a dozen pages of a useful chronological table. These facts and tables constitute the chief merits of the book, which, though fairly and evidently carefully written, yet fails in some very important particulars. Mr. Sanderson writes too much in the beaten track that has been shown to lead to error by modern research. A more diligent attention to the valuable labours of recent investigators, would have enabled the author to have avoided repeating oft-refuted errors. In commencing with the ancient Britons we have the usual vague statements about these people being at the time of the Roman invasion in a state of semi-barbarism, clad in skins, living in poor huts, and all the rest of such antiquated nonsense, including the notion that the weapons of flint and bronze were used by these Britons, instead of being referred back to their ancestors some thousand years at least before Julius Cæsar's time. The old story of the Britons being either extirpated or driven into the corners of Wales, Cornwall, and Scotland, is again told, as if no such writers as Pyke, Palgrave, Huxley, and Nicholas had dispelled such nonsensical conclusions from the vagaries of the shadowy Gildas. No notice is taken of the high intellectual development of the Druids, nor of the populousness and flourishing condition of the pre-Roman Britain in general. Some few words are given as heir-looms of the Celtic speech without any apparent suspicion on part of the author that words in our language traceable to a Celtic source may be reckoned by hundreds. The beautifully drawn figures illustrative of the Druids might suggest a doubt of the sweeping condemnation of their teaching being a mere gloomy and superstitious paganism tinged with horrible cruelties. Leaving this period, the author says, 'We may as well dispose of the well-worn and erroneous name, *Saxon Heptarchy*, by stating that there never were, at any one time, seven independent Saxon and English kingdoms.' This will be new to many writers who have strongly contended for eight and adduced grounds for several other small independent governments.

The general sketch of the Saxon period is fairly written, together with the social condition of the people. Alfred, of course, comes in for a large share of well-deserved praise, but we have been so accustomed to think about Alfred's good qualities as to become sceptical of his having had any bad ones. Yet it is indisputable that Alfred would have been benefited had temperance been a Saxon virtue. The same disposition to praise shows itself in many other instances with amiable obliviousness to failings. With so much attention to condensation of facts, however, the author has not much scope for argument or anything like detailed criticism.

Now, as the auctioneers say, 'with all faults,' the book before us will be of considerable service, and mostly, as we have said, as a valuable compendium of facts. The illustrations are for the most part remarkable examples of artistic excellence and appropriateness. We would particularly refer to the Druids, the head of Julius Cæsar, the figure of John Hampden, and some ships of various periods. We cannot award the same praise to the maps which are mostly dull and indistinct, with the exception of a remarkably clear one (at page 136) to illustrate the Wars of the Roses, and some other plans of battlefields. Some of the topographical views too are most excellent, as for example that of Sebastopol (p. 390), the Khyber Pass (p. 412), and Gibraltar (p. 283). Such illustrations are real aids to the understanding of the subject of the matter. The plan of the field of Waterloo (given on p. 362), helps more to the understanding of this notable contest than a very lengthy description. The view of the Bastille, also (p. 329), calls up a host of associations, and will be welcomed by all readers of modern French history. The story of India and its annexation to British rule is ably told. The same may be said of the American Revolution and its results. A remark respecting General Monk being specially designed by Providence for the safety of England led us to expect a very favourable if not flattering description of Charles II. But we were agreeably disappointed. This worthless king is duly held up to scorn and reprobation. 'He came back to England with the fixed purposes of being as independent of his Parliament and his people as he dared be, and of making up for past trials by a life of selfish ease and enjoyment. He cared not what he did, how he degraded the nation and himself, so long as these two objects could be obtained. It was for this that, when he wanted money, he sold the national honour and national possessions, and became the pensioner of Louis XIV., of France. . . . . He was full of wit, good humour, vivacity, and affability. He had but little heart, tenderness, virtue or conscience. He had no belief in women's virtue or men's honour. . . . . He was graceful and gentlemanly, with harsh swarthy features, but a pleasing expression. His real politeness and easy gaiety of air and conversation, charmed all who approached him. He was always popular.' This and more equally to the purpose, shows that Mr. Sanderson is capable of well describing matters of which he speaks from a full mind. The failure of the early portion of the book arises from the author's not giving such attention to the best sources of information that he has devoted to the later details of British history. On topics evidently congenial to the author he is rather apt to get into the 'high falutin style of fine writing. For this we are not altogether unprepared by his telling us in the preface of his intention 'to rise, upon occasion, to eloquence.' These occasional bursts hardly harmonise with the severe compression of facts

that mark many pages. Everybody was glad to see the end of the old window tax, but few would speak of this as 'a foolish and cruel impost, which deprived many people of a due share of heaven's free light and air within their homes.' The following example of Macaulay-and-water is almost too much for our poor weak heads :—'In truth, we are living in an age of wonders. The most familiar facts, the seen and felt realities of daily life, leave far behind the wildest dreams of fancy and of fiction. Electric fires, lighting our streets from sunset until dawn ; the photograph that makes the sun's rays print with faultless accuracy the features of man, or the charms of the landscape, or the beauteous lines of painting and sculpture, or the massive glories of the architect and of the engineer ; the roadways bored through mountains, the bridges flung for railways over straits and rivers, spanning alike smooth stream and ruffling tide ; the floating fort—with twenty-inch iron armour on its sides ; the cannon firing shot that weighs almost a ton ; the rifle raining bullets out at twelve a minute, with low and deadly aim in practised hands ; the drug that deadens pain, and makes unfelt the surgeon's dreaded knife, these, and a thousand other things of use and beauty, of marvel and delight, belong to the half-century of invention and construction and discovery, whose students and philosophers and engineers are still inventing, and discovering, and constructing with more restless energy than ever.'

Not much is gained by such rhetorical flourishes. Very much of the same highflown rhapsody might be applied to the days of the invention of printing, of the Reformation, of the Revolution, and of almost every notable epoch. We question, however, its suitability in a school history of England.

Murby's Scripture Manuals. The first Epistle to the Corinthians. By a Practical Teacher. London : Murby, Fleet Street.

This little manual will be valuable to students preparing for the university local examinations, and for pupil teachers who have to go through a theological course of study. The recommendation of the author for the student to read the text through 'carefully and thoughtfully again and again, to the twentieth time,' must be taken *cum granum salis.* Doubtless it would be well to read every book worth reading in this manner, but time and opportunity being insufficient to carry out such, their value may be questioned. We may say that this manual will help the student to form opinions and acquire the grasp of the contents of this epistle much better than could be done by all his efforts without some such aid. We should hardly understand ver. 22, chap. xv. : 'For as in Adam all die,' etc., to prove the resurrection of the natural or material body. This is plainly discountenanced by the explanation to ver. 41, 'NATURAL BODY,' *i.e.*, the human body in which the soul now lives. This animal body, which decays in the grave, is contrasted with the spiritual body, which will be raised.' We may indeed trace the material view of the resurrection to ignorance of the Apostle's expression, 'There is a natural body and a spiritual body,' and the failure to see that the spirit not only has form and spiritual substantiality, but greatly influences the form of the natural body, as is exemplified by the very look of a good man in contradistinction from a bad one. The want of due appreciation of the Apostle's meaning has led to the materialistic view of the resurrection, which has been a stumblingblock to many. The examination questions with which this useful little manual concludes are remarkably good.

A Synopsis of Butler's Analogy of Religion. By the Rev. R. O. Thomas. London : Murby, Bouverie Street.

We have had occasion to commend the labours of Mr. Thomas in his useful outline of 'Paley's Evidences,' and his skill is no less shown in the useful compendium before us. Important as have been the advances in Biblical criticism and natural theology, these great books of Paley and Butler yet retain their leading positions. No student can afford to neglect them, and the profit their reading develops in regard to lucidity and demonstrativeness no one can gainsay. The synopsis before us is a readable book and gives no unpleasant signs of being an abridgment of a larger treatise. Of course there are summaries interspersed as guides to the leading features of Butler, but the condensation generally is so well done as to convey no sense of incompleteness. To attempt to criticise Butler in a short notice of this synopsis would be sheer impertinence, but while Mr. Thomas has in a hundred pretty closely printed pages fairly introduced us to Butler he often also most judiciously shows how more detailed reading may be advantageous to the student. The few sections of examination questions are remarkably good.

Bell's Reading Books. Select Tales by Maria Edgeworth. London : George Bell and Sons, Covent Garden.

We are said to be making great advances in educational literature. But the past generation were not altogether in the helpless condition that many would fancy. An age that had Mrs. Barbauld, Miss Edgeworth, in addition to the ever welcome 'Robinson Crusoe' and 'Evenings at Home,' were by no means ill-provided with intellectual food. The inculcation of lessons of industry with which Miss Edgeworth begins her tale of 'Lazy Lawrence,' over whom the example of the 'Industrious Jem' at last prevails, is infinitely more likely to enlist the sympathies of youthful readers on the side of honesty and industry than much dogmatic teaching and preaching.

Of course, everybody knows that the charm of Miss Edgeworth's tales is their naturalness and simplicity. There is nothing forced in the character of Jem or his steps to success, nor in the downward career of his counterpart. At the same time the story is developed into an interesting ending, and the detection of the youthful robbery is as natural and probable as every other feature.

Next we take up the capital story for schoolboys of Tarlton, and at once see how poor Loveit's indecision will end. The unswerving uprightness of Hardy is, perhaps, less skilfully portrayed than the blandishments, mockery, selfishness, and thorough cowardice of Tarlton. We become increasingly interested as the tale proceeds, and feel the usual relief at Hardy's innocence being established and Tarlton expelled with ignominy. The story of Susan is more ambitious, being a well-developed novelette. Here, again, the trials of Susan and her father and mother at once enlist the reader's sympathy, while indignation is equally roused against the temporary success of the artful schemer and trickster, Lawyer Case. There can be no question regarding the value of thus engaging the sympathetic interest of youth on the good side, and to see also that though the right path may be for a time overshadowed by clouds, yet these will clear away and leave those who walk uprightly to enjoy the cheering sunshine. Doubtless dogmatic teaching has its place ; moral lessons should not be omitted ; higher appeals may come in at appropriate seasons ; but the good effects of such tales as Miss Edgeworth's, wherein the moral is not thrust unduly forward, nor the 'goody goody' preachments made predominant, are unquestionable.

We may add that Messrs. Bell have brought this book out in a cheap form. No fault can be found with the printing nor with the binding, though plain. But we have a schoolboy's hankering to see these tales accompanied with such illustrations as the publishers have added to their edition of the 'Pilgrim's Progress.'

Home Gymnastics. For the Preservation and Restoration of Health. By T. J. Harletius, Stockholm. Translated by C. Löfving. London : Isbister, 56, Ludgate Hill.

We have not quoted the title of this book in full, but probably stated enough to indicate its design, which is to

prevent, if possible, and in many cases to try to cure bodily ailments by exercise. This, usually laid down on very broad or general principles, is here detailed and applied in a systematic method. The general influence of bodily exercise in regard to the healthy condition of the human organism is described in reference to the blood, the functions of digestion, respiration, and the secretions, together with the general nervous system and condition of life. This is followed by a description of movements for specific purposes to strengthen organs or parts of the body requiring additional exercise, or rather exercise to make up for the deficiency of bodily activity consequent upon sedentary occupation.

The book opens up the whole question of the conditions of health by showing how this may be best preserved by judicious muscular exercise. By the neglect of this various parts become more or less congested, and functional activity impeded. To remove these evils recourse is had to medicine, generally of a purgative nature, n order to prevent the blood becoming more impure by the absorption of food in excess of the quantity required by lethargic muscular action. This continued resort to medicine in time plays sad havoc with the digestive powers, and is a mere temporary relief from the evils of inactivity. Exercise, however, though wisely recommended as a preventative, often fails from being insufficiently specified and carried out in reference to the evils to be remedied or the particular muscles to be strengthened. In the book before us the most prevalent forms of disease are described, and the kind of exercise detailed for cure or prevention. Diagrams are given in all cases to illustrate the directions. In several cases a series of prescriptions are given, beginning with a series of easily performed movements and progressing towards difficult ones—the latter not to be undertaken, of course, till health and strength warrant the performance. Too frequent changes are to be guarded against, and, generally speaking, a higher exercise should not be attempted till the salutary influence of an easy one becomes diminished. Of course, the general free play of muscular activity is the mainspring of vitality in youth, but systematic exercises are by no means thus rendered superfluous. It is only by the judicious action of all the muscles of the body that the harmonious development of all parts is secured and a one-sided inequality avoided.

Physical education is now happily receiving its due share of attention. Our young scholars will become less specimens of the 'all head and no body' examples that formerly formed the majority of pupils. In many cases life was shortened, and in all rendered less happy and healthy by the want of physical exercise. The no less serious evil of bad ventilation is also receiving due attention, together with the alleviation of old physical errors that often degenerated into positive torture.

The chapter on swimming forms a good ending to this altogether excellent book, which ought to be 'strongly recommended by the faculty.'

Limen Latinum. A Latin Book for Beginners. By C. H. Gibson, M.A. London: Relfe Bros.

We have carefully perused this book, and the result of our investigation is completely satisfactory. We were indeed taken with the general appearance and get-up of the book, before we proceeded to read. It is beautifully and clearly printed on fine paper, and distinctive types, so essential to a work of this kind, are adopted. Mr. Gibson possesses two qualifications, which are indispensable to writers of educational books for beginners—scholarship and experience. It is now universally admitted that as much, if not more experience is necessary for teaching the young; and the same rule, we take it, applies to educational writers for the young. As Mr. Gibson sets forth in his preface, its great merit is its simplicity combined with its practicability. He has gone on the lines of the well-known Public School Latin Primer, but he has presented the grammar covered by that book in a better, simpler and more systematic method. One of the great faults of the old primer, we think, is the excess of notes in the shape of small print. This confronts the beginner, not only after he has gone on with the book for some time, but even at the threshold. This stumbling-block has been removed in the work before us, and what is most important the matter contained in the small print before alluded to is put in a simple and readable form. The grammar, as we said above, is more systematically arranged. We will give one instance of this. The Calendar in this book is placed in its natural position next to the numerals. In the Public School Latin Primer, such was our perhaps unpardonable ignorance in our early days, we knew not of the existence of a Calendar, and we were awakened to a sense of our iniquity by having it pointed out to us somewhere at the end of the book, relegated to an appendix along with another mass of small print. And the rules, being of importance, are boldly printed, and clear illustrations given. The same plan of natural arrangement is pursued throughout the book. We think we can discover the reason of an apparent deviation. The compounds of the Relative and Indefinite Pronouns are placed at the end of the book to avoid distracting the minds of boys who have just been hard at work on Pronouns in their great variety of forms.

But we have not properly pointed out the plan of the book, till we state that it is a combination of grammar with exercises thereon. In the exercises, as in the grammatical portion, Mr. Gibson has bestowed much careful attention.

The old cry against exercises was that they were uninteresting—nay, in many cases they were absolutely childish. We can most of us remember the ancient 'Balbus is building a wall,' 'Cæsar runs,' and the like. Mr. Gibson has followed the plan adopted by Dr. Bradley in his book on Latin Composition, and has given us for the most, examples taken from Latin authors, thus making them as interesting as possible. The exercises too on the different rules are remarkably full and at the same time carefully graduated. By no means the least important feature of the book is the copious vocabulary—Latin-English and English-Latin at the end of the book. Two or three meanings are in many cases supplied to a word, and other information is invariably added. In conclusion, we have only to say that the book has been written throughout with great care and the quantities of the Latin words carefully marked. We should be glad to see a Greek Grammar treated on the same basis, for we are sure that it would meet with as much approval as this must at the hands of those who have the education of the young to attend to.

What Her Majesty's Inspectors Say. Darlington: North of England School Furnishing Co.

We congratulate Mr. Clifford upon the appearance, for the second time, of his carefully-prepared digest of the English and Scotch Blue-books entitled, 'What Her Majesty's Inspectors Say,' and issued by special permission of the Education Department. Those of our readers who are unfamiliar with the work will get the best idea of it if we quote the title page:

'What Her Majesty's Inspectors say—being their reports (1880-1881) for England, Wales, and Scotland, classified, paragraphed, and arranged in the following order:—Analytical Index, Preface, Reading, Writing, and Spelling, Arithmetic, Geography, History, Grammar, Literature, Music and Singing, Domestic Economy, Cooking, Needlework, Specific Subjects, Infant Schools, Evening Schools, Pupil Teachers, Discipline and Drill, School Premises, and Miscellaneous, with a copious summary, and an appendix consisting of the "Proposals for the New Code."

We can confidently recommend the book; we should be glad to learn that it had found its way into the hands of every teacher and educationist in the kingdom.

Religious Knowledge Manuals: How to Teach the Old Testament. By W. Benham, Vicar of Marden, Stapelhurst. London: National Society.

No one can help admiring the spirit of this book, and the devout tone in which it is written. In regard to methods of teaching, Mr. Benham's remarks are more suggestive than methodically descriptive. Not that we regard this as an evil—scarcely a defect—as each teacher and student had better be left to the development of his own plans and resources than to be encumbered with details unsuitable to his taste or knowledge, which, like Saul's armour, would be more encumbrances than aids. In taking down notes, Mr. Benham wisely advises a short reference to the treatise or book in preference to the copying of long notes from books, which 'takes a long time, and generally you do not read them afterwards. Only make a reference, and that to works within your reach.' Again, 'Perhaps the time is gone by when children were made to read genealogies from Nehemiah by way of penance.' True, and well said, except that many mistaken teachers insisted on the learning of such lessons 'not by way of penance,' but out of a mistaken idea of edification. Some years ago a series of such painfully inappropriate lessons purporting to be written by a country vicar, were published in the monthly paper of the Society which now more wisely issues such books as Mr. Benham's. Another wise recommendation by Mr. Benham is to resort to pictorial aid as much as possible. In this there are abundant resources of the most attractive nature. There is scarcely an educational shop in which good Scriptural pictures may not be found, and some of these are of the highest artistic excellence. Many years ago the S.P.C.K. issued a series of outline drawings on large sheets, of a bold but well executed character. These were as useful for excellent drawing examples as also for Biblical teaching. Similar beautiful specimens are now issued by the Wesleyan publishing office, as well as by the National and Christian Knowledge Societies.

The list of lessons suggested by Mr. Benham is good and practical. These follow what may be termed the explanatory step, and give the most prominent Scriptural aids to lessons against *anger*, *envy*, *evil company*, *pride*, and other evils, and the value of *prayer*, *humility*, *justice*, and other virtues, together with the leading doctrines deducible from the Old Testament.

The latter half of Mr. Benham's book gives an outline of the leading features of Biblical history, including a summary of the rulers before, during, and after the Captivity. The dates affixed to this list will be very useful. Some of the latter portions of the book may be thought too sermonizing, but with so much to approve of, it would be ungracious to indulge in captious remarks. The price, too, is moderate, and the 'get up' unexceptionable.

The Young Student's English History Reading Book. London: National Society.

This book is the advanced part of a former volume, and is well adapted to its purpose. It is written with much more scholarly thoughtfulness than a host of the compilations that the New Code has called into existence. Where fulness of detail is unsuitable, suggestive hints are given by which the young student's course is well pointed out. Much greater attention has been given to domestic history than is commonly bestowed even in some books professing to treat of the condition of the people. Many of these sketches are remarkably well done, and bring the scenes described before the view so as to thoroughly command the reader's attention. In tracing the origin of our Teutonic ancestors the author very properly sweeps away the fallacies associated with the term *Saxon*. He attributes the correction of this popular error to Mr. Freeman; but several others have aided in clearing this portion of history. It was doubtless the Romans who first applied the term Saxon—the name of the southern tribe—to the other people of Northern Germany, and historians have, for the most part, since 'blindly or lazily fell in with this example, to the infinite misguidance and confusion of themselves and of their readers.' The Angles, though the last of the great tribes that came over, were by far the most numerous, and 'so clearly took the lead of the tripartite confederacy [of Jutes, Saxons, and Angles], that the whole body of the Teutonic invaders of Britain came to be known as Angles, or Englishmen.' All three tribes, as the author further remarks, spoke 'English,' not 'Saxon,' and the term Anglo-Saxon, then unknown, and only adopted after the Conquest, was a misleading afterthought. With so much that is interesting and original in the sketch of the Teutonic tribes, we regret that the attention of the writers was not equally directed to the earlier inhabitants—the Britons. But a reliable history of these people is still to be written. The author falls into the exploded error of the Britons being completely exterminated by the Saxons, notwithstanding the writings of Pike, Palgrave, Nicholas, and Huxley, together with the more irrefragible testimony of language, length of time occupied in completing the Saxon rule, and that of ethnology. The latter portion of the book is somewhat impaired by important omissions. Nothing is said of the great Free-trade legislation which for nearly a quarter of a century was the most prominent topic of English political life. The author professedly avoids treating of the events of the last ten years, probably with the desire to avoid irritating topics; but while the story of the Indian Mutiny is told, together with that of the Crimean War, room should have been found for some mention of the great fiscal change carried by Sir Robert Peel before his lamented death in 1850. We are aware that this book does not profess to be a consecutive history of England; but the student should be aided, as in other parts of this book, with hints for study of the topics omitted. Altogether this book cannot fail of giving new and vivid impressions in youthful readers of the most salient points connected with our national progress. The book is beautifully printed on excellent paper, and with type that makes reading not only easy but luxurious.

Johnston's Natural History Plates. London and Edinburgh: W. and A. K. Johnston.

We have received three of this series of plates, viz., that of the Donkey, the Pig, and the Roe or Red Deer. The series comprises some fifty examples already published, with a notice that others are in preparation. We are unwilling to speak otherwise than in unqualified admiration of a scheme of illustrations so liberally designed, and the publication of which must greatly aid the knowledge of Natural History. But we are impressed with a decidedly foreign look of the specimens before us, at least in regard to the pig and the donkey, which have a decidedly German look. The snout of the sow, which occupies the two-thirds of the breadth and one-third of the height of this large drawing, is an enormous projection with a more enormous termination. In the middle of the picture is a better bred pig, with a respectable tapering snout, and a nice convex back that would fit him for the company of the respectable porcine members for Berkshire or Hampshire. The right-hand corner again is occupied with an animal we suppose intended to represent a youthful pig, but its exceedingly long legs give it more the appearance of a calf. The donkey, too, has very high legs, and an enormously wide mouth. In fact, the head would be discountenanced by any respectable donkey. Young Hans, while leading his asinine friend to an adjacent thistle, is duly attending to the directions of Hans senior, before whom a smaller donkey stands much too heavily laden. The deer seem to us much more like our denizens of Windsor and other forest-parks, being, with the exception of an unnaturally long hind-leg on the leading character, boldly drawn, well coloured, and with capital umbrageous background, of which the lower part of the trunk of a noble tree is relieved by a graceful mass

of undergrowing foliage. Some of these German artists might do well in studying Harrison Weir. The drawings are beautifully coloured and highly effective.

Mechanical Industries Explained. By Alexander Watt. Edinburgh and London: W. and A. K. Johnston.

This book will be very useful to the general reader in stimulating inquiry and enlisting interest in various mechanical pursuits, some of which verge on the work of drawing-room ornament which ladies often perform with skill and taste. Nothing is more needful as a supplement to the book part of education than some employment involving physical effort for leisure time. This may often be termed a hobby, but every one ought to have some hobby, even if it be that of lock-making, pursued by Louis XVI. of France, or that of clock-making carried on by the Emperor Charles V. Music and drawing were formerly regarded as mere amusements for leisure, but have now become a serious business from whose study relaxation is required. This relaxation will be abundantly gratified by the details of Mr. Watt's interesting book, in which we are taught the light dexterities of gold-leaf ornaments and the making of rustic flower vases, to the heavy labour of brick making and bronze-casting. Of course a selection must be made in regard to mechanical operations, and for the leisure hours of most people the lighter kind that may be carried on indoors may be said to be generally preferable. Of these, the book before us contains clear instructions on papier-maché, crayons, etching, carving Irish bog-oak, lithographic drawing, the process of French polishing, and several occupations that may be carried on indoors. We too often find leisure time on the part of women restricted to a few operations connected with needlework or its less useful associates—crochet, wool-work, and the like—each of which have a 'run,' and are then thrown aside. The time that has been in most cases wasted on the making of those useless things called antimacassars would have been infinitely better employed in the old-fashioned work of knitting gloves or stockings. But in the book before us a variety of tastes can be gratified, the intelligence exercised, and articles of utility and taste produced. No objection ought to be urged against this book that it contains descriptions of important manufactures. If read it can scarcely fail of improving every household.

Geographical Reader: England and Wales. By J. M. D. Meiklejohn. Edinburgh and London: W. and R. Chambers.

This book forms the third of Messrs. Chambers' Geographical Reading Books, and is quite up to the average of most books on the same subject. It combines a fair amount of explanation, with a regular sequential statement of facts and descriptive outlines. For reading lessons on geography we should prefer more discursive explanations, and leave the regular topographical details to the usual text-books; but we must take what the gods—or rather, the publishers—give us. Messrs. Chambers have done their part well in an abundance of maps, several of which are worthy of particular notice in being novel, clear, and of great use in aiding the understanding of the text. The growth of London, for example, is shown to the eye by a map differently shaded from a central small black patch representing the London of 1600; this is encompassed by a shaded portion showing the extent of the metropolis in the middle of the last century; and this again by a less darkly shaded map indicating London of the middle of the present century; while the London of our days is shown by a lightly shaded map extending from Woolwich on the east to Brentford on the west, and beyond Brixton on the south to Stoke Newington on the north. Maps of the coal-fields, of the woollen and cotton districts, also of groups of counties, are equally clear and useful. So also is the map (page 104) showing the main lines of railway that converge on London, whereas the map of England (page 109), showing the railways, puts us in mind of a skeleton leaf, with its network of lines—most likely correct enough, but of which the eye gathers nothing but the impression of an intricate mass of lines. Mr. Meiklejohn has given a fair outline also of the principal social features of the English, and their prevalent industries. A little sketch is given of the traces of history in English place-names—an interesting topic, and one that is justly receiving increased attention in modern books on geography. This chapter is less accurate than might be expected from the ability that marks most other portions. The following is vague: 'The names of places in England are Roman, that is to say, Latin; Celtic, called in England Welsh; Teutonic, in other words English; and Scandinavian or Danish.' Most scholars would quarrel with all these asserted synonyms. Mr. Meiklejohn also explains *Watling Street* as the *Street of the Pilgrims* (*vadla*). Again, we have *Islington* explained as *the Town of the Little Sons of Isa* (which was a man's name among our ancestors) and *Newington*, the *Town of the Sons of New*. All this will be new to many who are aware that *ing* is an Old English termination for meadow, as well as for *son*, and in the former sense we have *Worthing*, *Goring*, *Lancing*, *Angmering*, and many other low lying meads stretching from the foot of the South Downs to the sea-board. *Newington* we should take to be a new town or place (as we call a collection of dwellings) on a piece of meadow land. *Islington*, doubtless, received its name from its mineral waters. We should conclude that Mr. Meiklejohn had not travelled much south of the Tweed from his calling Ely, with its streets of cobbled stones, a fine cathedral city. Dover, said to be 'the largest town in the county (of Kent),' is less populous than Gravesend, Greenwich, and some other Kentish towns. 'Kew and Richmond,' we are told, 'are two pretty towns on the Thames, each with a royal palace.' The little village of Kew must feel itself highly honoured at being raised to the dignity of a *town;* and the palace of Richmond, long ago demolished, now comprises a mere vestige of a bit of an old wall. Greater accuracy is needful also than to speak of the *North Downs* as crossing Sussex. Again, we are surprised to learn that Runnymede, adjacent to Egham and Staines, is 'not far from Kingston'—a distance of about ten miles is hardly to be thus described. Neither should we speak of Surrey as one of the hop-growing counties, as its only hop-gardens are on the Hampshire end of Farnham. We fancy also that the people of Essex will demur to the statement that richness of soil being by implication limited to its western parts. These in reality are more hilly and less rich in alluvial deposits than the eastern. But the entire county is fertile. Our ideas of geographical reading books are for the prevalence of explanatory remarks above a bare enumeration of facts and names. These latter, when given, should be accurate, and the most salient points given by way of description. Much is to be done to explain why certain industries are carried on in certain localities, together with the history, rise, and changes of such specialities. These are topics to be read about, and reasoned upon, as well as those more closely connected with physical geography. Mr. Meiklejohn has in this book done a little in the way we suggest. We wish he had done more.

Science Manuals: Sound, Light, and Heat. By Alfonzo Gardiner. Manchester and London: Heywood.

We have no fault to find with this book except in regard to the paper on which it is printed. This defect is almost painfully apparent on many pages, owing to the diagrams being drawn on blocks with a black ground. In all other respects the book is entitled to great praise. Its descriptions are clear and succinct, with the addition, where needful, of equally lucid explanations. Words are also, where necessary, etymologically traced, and in several cases clear arithmetical workings are given of

important test questions. After carefully mastering the contents of this little manual, the student is shown how best to prepare for the crucial test of filling-up an examination paper by a series of *home exercises*, in which the proper work of memory is shown, and the most suitable questions given to be correctly and neatly written. These, if properly examined by the teacher, will almost annihilate the chances of failure. A series of questions is appended comprising the examination papers of the Science and Art Department from 1872 to the present year. For fuller information the student is referred to the best modern treatises on the respective subjects named. But to all students we would say *master this book first.*

A Method of Teaching the Deaf to Speak. By Thomas Arnold. London: Smith, Elder and Co.

Cold must be the heart, and dull the mind, of any one failing to sympathize with Mr. Arnold's purpose and efforts. The deaf, he tells us, if left shut out from the intelligences opened by the exercise of speech, 'is immured in the merest animalism. You [the teacher] are to open his prison doors, and bring him forth to think and speak, that the light, and life, and liberty of the sons of God may be his also. Never count the cost. It may wear you and weary you, but it will bring you into closer fellowship with Him who opened the eyes of the blind, and unstopped the ears of the deaf.' These are noble words, and should animate all in the discharge of duty, but are doubtless more than usually needful to sustain and encourage the efforts of those who try to teach the deaf to speak. Mr. Arnold speaks with the authority of experience, having laboured for upwards of twenty years in the education of the deaf, and with such success that one of his pupils, Mr. Farrar (who began *de novo* at the age of three years, being then absolutely deaf and dumb), after passing the Cambridge Local Examination, matriculated last January in the London University. Mr. Arnold enters thoroughly into the history of the efforts that have been made in this field of philanthropic labour, from St. John of Beverley—whose so-called miraculous cure is capable of being explained as being largely connected with the skill connected with the process of imitation—to the philosophic Cardan, the more practical Abbé de l'Eppée, and so on down to the modern labours of Hill, Braidwood, Dr. Watson, and the congress held in 1880 at Milan, over which the Abbé Giulio Tarra presided. Ample details are given of the complexities of articulation, and the variety of sounds to be uttered, but the explanations appear to be so lucid, philosophical, and practical, that all who resolutely set to work may, by the aid of Mr. Arnold's book, be certain of success. Of course, much has to be done from the first steps of developing the utterance of sounds more plainly perceptible by lip-signs, such as *papa*, *vile*, and others beginning with p, b, f, or v. But these, when connected with written signs, and, when necessary, with other illustrations, as, for example, that on Prepositions, page 129, become the valuable foundations on which the superstructure of further progress depends. Mr. Arnold has spared no pains in producing an excellent book, which will be indispensable to every teacher of the deaf. The paper, printing, and illustrations are excellent, and we may add also the strong and thoroughly good binding, which will stand much wear and tear while preserving its comeliness. The price of such a book must needs be somewhat high, but the cost of a few extra shillings vanishes before the great importance of the book to those who need its aid. It must be considered as the standard book on tho subject, and is in every respect well worthy of this position.

Ward and Lock's Universal Instructor. Part 13.

This excellent serial still keeps up to the high standard of the earlier numbers.

Gill's Physical Exercises, with Musical Accompaniments. By R. H. McCartney. London: Gill and Sons, Warwick Lane.

Soldiers march better to the playing of a band than without, and the schoolboys' fife and drum bands greatly aid in developing regularity and precision in marching, in sustaining attention, and also in relieving the feeling of weariness attendant on physical effort. The same beneficial results will doubtless be connected with the use of music in the system of physical exercises known as 'drill.' These exercises often become tedious from an absurd habit many drill-masters have of making long pauses—probably with the idea of giving rest, but, generally speaking, with an opposite effect—between the movements. The unceasing progress of the swing of the music will greatly check this delay, and keep all 'going' without prolonged pauses. In Mr. Gill's book the exercises are well developed, and accompanied with good and abundant illustrations, together with all needful explanations and directions. Mr. McCartney's idea is good in regard to the music and the suitable collection of airs, mostly martial or suitable to marching movements. But they are arranged beyond the powers of any but good players. If the melodies given had been very much more easily arranged, they would have served the object better, by enabling even pupil teachers to play them. There is scarcely a bar in the present collection that is not marked by a change of the bass chords at every beat. This continued extension work for the bass hand places the music out of the reach of most amateurs. As musical exercises the arrangements and harmonies are unobjectionable, but this is not the main design of the book. The melody from Meyerbeer, No. 13, involving a continued sequence of triplets, is also less suitable for marching than such melodies as Nos. 5 and 15, marches from Bellini's operas, and also No. 1, from Verdi. Even these operatic airs, good as they are, might be advantageously mixed with a few of the ever-taking melodies of the Yankee Doodle and Tommy Dodd school; or, if foreign music must be had, let it be such as the capital march movement of 'Le Petit Tambour,' which Hickson, the first writer of English school songs, so admirably adapted to the words, 'Come, let us march and sing.' We doubt not but the systematic exercises of this book will be highly valued.

MESSRS. T. NELSON AND SONS' PRIZE BOOKS.

Beyond the Himalayas. A Story of Travel and Adventure in the Wilds of Thibet. By John Geddie. London: T. Nelson and Sons, Paternoster Row.

Mr. Geddie says, in the preface to this very interesting and ably-written book, that the problem of opening up an overland route from the Ganges to the Yang-tze ought to have some attraction for the imagination of young people, if they take as much delight in travel and adventure as they are generally supposed to do. He has therefore given us in his present volume an account of the supposed travels of a party of friends who passed through the wild mountain fastnesses and wide table-lands of Thibet, and has made his narrative as accurate as the diligent study of the best authorities will enable it to be. We venture to say that the boy who is fortunate enough to possess a copy of this book will not only be interested, but that he will acquire a large amount of very useful geographical and scientific knowledge. He will learn a great deal about the almost unknown land which lies beyond the wall of China—a land said to be wrapped in mental and spiritual darkness. The book is extremely entertaining, and is embellished with capital woodcuts. The binding is rich and pleasing in colour, and we can give the book no higher praise than to say that it is as instructive as it is amusing.

The Rocket; or, the Story of the Stephensons—Father and Son. By H. C. Knight. London: T. Nelson and Sons, Paternoster Row.

We hail the appearance of a new edition of this really admirable little book with pleasure. Years ago, when very young indeed, we read Mr. Knight's graphic account of George Stephenson's early labours, and how they brought him to riches and honour. No better book for inculcating principles of perseverance and honesty than this could be found, and we earnestly recommend all persons who have boys under their care to make them a present of it. The edition before us contains an additional chapter, in which the author speaks of the recent Stephenson Centenary, and of the development of the great work originated by the man who was once a poor lad. The book is well printed and bound, and the text is illustrated by no less than twenty-six engravings.

The Search for Franklin. A Narrative of the American Expedition under Lieutenant Schwatka. London: T. Nelson and Sons, Paternoster Row.

This little book gives us, in a neat and compact form, many interesting details of the search for Sir John Franklin conducted by Lieutenant Schwatka. It is furnished with excellent maps and illustrations, and will be prized by all boys who love adventure and maritime enterprise. While reading the account given here of the many attempts to discover the North-West Passage, we are strongly reminded of the lines of Mr. Tennyson which so well epitomise the spirits of discovery and boldness:—

'The bodies and the bones of those
That strove in other days to pass,
Are withered in the thorny close,
Or scattered blanching on the grass.
He gazes on the silent dead:
"They perished in their daring deeds,"
This proverb flashes through his head,
"*The many fail: the one succeeds.*"'

We suppose that the checks which our great Arctic explorers have experienced will only serve as an incentive to others to go forth to do battle with the ice and snow. The book before us will fire many a boy with enthusiasm; and, for anything we know, it may directly influence the one who is to succeed where the many have failed.

Tempered Steel; or, Tried in the Fire. By Rev. E. N. Hoare, M.A. London: T. Nelson and Sons, Paternoster Row.

Edward Ridley, the hero of this story, is of a type which is not unfrequently met with. He is a lad of good resolutions, amiable, kind-hearted, and manly, but easily led away by his companion, Ronald Cremer, a young man of extravagant and *gauche* habits. Mr. Hoare's little book is calculated to do good, and we commend it to the notice of parents and guardians.

Great Heights gained by Steady Efforts; or, Perseverance and Faithfulness Triumphant. By Rev. T. P. Wilson, M.A. London: T. Nelson and Sons, Paternoster Row.

Mr. Wilson's well-printed and strongly-bound volume is intended to convey a salutary lesson to young people. The story is very interesting and clear, and the 'get-up of the work renders it a most desirable reward or gift-book.

Alpine Climbing. By the Author of 'The Arctic World.' London: T. Nelson and Sons, Paternoster Row.

We have in this little work some very trustworthy narratives of recent ascents of Mont Blanc, the Matterhorn, the Jungfrau, and other lofty summits of the Alps. The ascents made by Professor Tyndall, Mr. Leslie Stephen, Mr. Alfred Wills, and other well-known mountaineers, are here graphically described; and there is a full account of that dreadful accident which happened on the Matterhorn in July, 1865, by which Lord Francis Douglas and his two companions lost their lives. Having resided in a mountainous district, we are naturally pleased with this book, and would fain linger over its pages. We are sure that it will encourage a love of travelling in many, and will tempt people to visit Switzerland with a view to ascending the 'Monarch of mountains'—Mont Blanc. The printing and binding are faultless, and there are thirty-four capital illustrations.

Stories about Dogs. By Mrs. Surr. London: T. Nelson and Sons, Paternoster Row.

In every way this is a delightful book. The choice of title is so good that no words of ours are needed to describe the contents. We will only say that the literary work, the illustrations (which, by the way, are from Mr. Harrison Weir's pencil), the printing, the binding, and the paper are alike excellent. Mrs. Surr's charming volume has our heartiest praise.

MESSRS. GRIFFITH AND FARRAN'S PRIZE BOOKS.

William Tell, the Patriot of Switzerland. By Florian. London: Griffith and Farran, St. Paul's Churchyard.

The anonymous writer of this book has sketched out a good trustworthy history of the Swiss patriot, which will be read with interest by children. We could wish, however, that the opening sentences of the first chapter had been written in a little less declamatory style. The printing is well done, and the binding exceptionally pretty.

Good in Everything; or, The Early History of Gilbert Harland. By Mrs. Barwell. London: Griffith and Farran, St. Paul's Churchyard.

Mrs. Barwell has here given us a pleasant little book, the object of which is to make children see 'good in everything.' She draws many useful lessons from animate and inanimate objects, and specially dwells on the necessity of being kind to animals. We are very glad to observe that this book, like the last, is printed in a type which will not harm the eyes of the little people for whom it is intended. The binding is neat and durable.

Hurricane Hurry; or, The Adventures of a Naval Officer Afloat and on Shore. By W. H. G. Kingston. London: Griffith and Farran, St. Paul's Churchyard.

The late Mr. Kingston's works are so well known that it is superfluous to praise them. They are healthy in tone, exciting, and eminently calculated to influence boys for good. 'Hurricane Hurry,' now in its eighth thousand, is full of good qualities. We feel sure that any boy will be proud to own this excellent tale.

Our Little Ones. Volume I. London: Griffith and Farran.

From our remarks in another column our readers will be able to form a pretty accurate idea of the merits of this volume. It makes a first-rate gift-book. Our own little ones have spent happy evenings looking at its clever pictures, and listening to its well-written stories.

We Four. By Mrs. Reginald Bray. London: Griffith and Farran.

We should not like our children to read this book, though we entertain no doubt of the good intentions of the authoress. But it comprises the youthful career of a young girl who is left motherless at the early age of four, and who tells her own tale of being the leading spirit of impetuous, wilful, thoughtless, and often spiteful and dangerous mischief. A moral is supposed to be drawn from little Cecil's confessions of carelessness and love of practical jokes; but we fear that the sympathies of youthful readers will be too much attracted to the fun of the tricks, and the moral be skipped or little heeded.

Query Column.

☞ **As the answer to a single question often entails an expense six or seven times greater than the cost of the complete key to any of the Arithmetics or Algebras ordinarily used, the Proprietor of this Journal would be glad if students confined themselves to questions, the full working of which is not published in the form of a 'key.'**

RULES.

1. Each correspondent is restricted to *one question.*

2. No query can be answered unless accompanied by the real name and address of the sender, not necessarily for publication, but as a guarantee of good faith and for facility of reference.

3. Replies will not be sent through the post.

4. Correspondents are requested to write *legibly*, and on one side of the paper only.

5. Correspondents wishing us to recommend books for any (other than the ordinary Government) Examinations, or to answer any questions concerning that Examination, must, in all cases, send a copy of Regulations up to date.

6. Queries must reach the office *not later than the 15th of the month*, or they cannot be attended to in the following issue.

*** All communications for this column should be addressed

'*The Query Editor*,'
The Practical Teacher,
Pilgrim Street, Ludgate Hill,
London, E.C.

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1. X. Y. Z., Netteswell.—A can do a piece of work in 10 days which B can do in 8: after A has been at work upon it 3 days, B comes to help him; in what time will they finish it?

It is not all necessary to use Algebra.

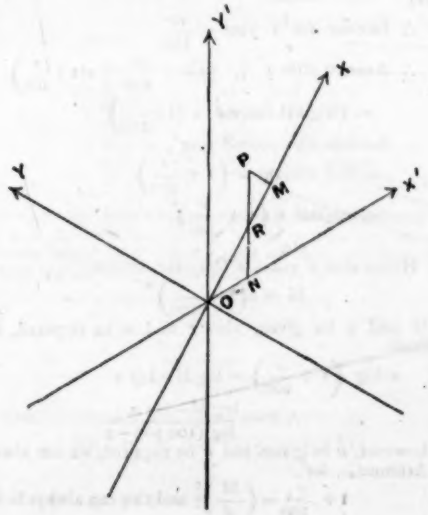
A does $\frac{1}{10}$ of work per day.
B " $\frac{1}{8}$ " "
In three days A has done $\frac{3}{10}$
∴ there are $\frac{7}{10}$ths left
A and B together do $\frac{1}{8} + \frac{1}{10}$ per day
i.e. $\frac{9}{40}$ per day
∴ they will do the work in $\frac{40}{9}$ days

∴ they will do $\frac{7}{10}$ths of it in $\frac{7}{10} \times \frac{40}{9} = \frac{28}{9}$ days $= 3\frac{1}{9}$.
The days are of course reckoned from their becoming partners.

2. P.P., Bromley.—If (x, y) (x', y') be the co-ordinates of a point referred to rectangular and oblique systems with the same origin, and if the axes of the first system bisect the angles between those of the second, then

$$x = (x' + y') \cos \frac{\omega}{2}$$

$$y = (x' - y') \sin \frac{\omega}{2}$$



In the diagram the arrowheads mark, as usual, the positive directions of the axes

$$x' O y' = \omega \therefore x O y' = \frac{\omega}{2}$$

Let P be any point PM $= y$ OM $= x$ PN $= y'$ ON $= x'$
Then OM = PN cos PRM + ON cos RON
$\therefore x = (PN + ON) \cos RON$, (for PRM = NRO = RO$y'$ = RON)

$$= (x' + y') \cos \frac{\omega}{2}$$

$$y = PM = PR \sin RON$$

$$= (PN - NR) \sin \frac{\omega}{2}$$

$$= (y' - x') \sin \frac{\omega}{2}$$

There is a sign wrong in your formula.

3. T. WILLIAMS, Oswestry.—I bought 100 cards for 9s. 2d., and sold the lot so as to gain $\frac{3}{7}$ of the selling price. Find the selling price and my gain per cent.

Suppose the selling price was 16s., the gain is $\frac{3}{7}$ of selling, or 6s.

∴ buying price is 16s. − 6s. or 10s.
but the buying price is actually 9s. 2d. $= 9\frac{1}{6}$s.
Hence as $10 : 9\frac{1}{6} :: 16$: selling price.
∴ selling price $= \frac{44}{3} = 14$s. 8d.
Gain is 5s. 6d.
∴ Gain on $9\frac{1}{6}$ is $5\frac{1}{2}$
on $\frac{11}{6}$ is $\frac{11}{2}$
on 10 is 6
on 100 is 60

Answer 60%.

4. ENQUIRER, Saint Clears.—How high must a person be elevated above the earth's surface, so that he may view one-half of the whole world?

Considerably beyond the Pole Star, for he would never be high enough.

The general investigation is the same for a circle as for a sphere. Suppose we have a circle with centre C, and an observer stationed at P outside the circle. Let PA, PB be the tangents to the circle from P, and let PC meet the circle in D. Then the extent of the circle viewed by the observer is ADB. To find this, let PD $= h$ {the height above earth}. CD $=$ CA $=$ CB $= r$ {the radius of earth}

Then $\cos DCA = \frac{r}{r+h}$

$\therefore DCA = \cos^{-1} \frac{r}{r+h}$ $\therefore BCA = 2 \cos^{-} \frac{r}{+h}$

$\therefore$ at the height h the observer sees the following fraction of the earth's surface—

$$\frac{2\cos^{-1}\frac{r}{r+h}}{2\pi} \text{ or } \frac{\cos^{-1}\frac{r}{r+h}}{\pi}$$

If this is $\frac{1}{3}$ $\quad \cos^{-1}\frac{r}{r+h} = \frac{\pi}{2}$

$$\therefore \frac{r}{r+h} = \cos\frac{\pi}{2} = 0$$

This involves either that r should vanish, or that $r+h$ should become infinite. But r is always finite; $\therefore$ h is infinite, or the observer must be infinitely removed before this can happen.

5. NIGER, Retford.—Multiply $1\ell7$ by $2\ell6$ in the duodenary scale, and prove the answer by reducing multiplier, etc., to denary scale.

Any ordinary *Algebra*, Todhunter or H. Smith, would suit.

$$\begin{array}{r|l} 10 & 1\ell7 \\ \hline 10 & 23,\ 1 \\ \hline & 2,\ 7 \end{array} \qquad \text{Ans. } 271.$$

$$\begin{array}{r|l} 10 & 2\ell6 \\ \hline 10 & 35,\ 4 \\ \hline & 4.\ 1 \end{array} \qquad \text{Ans. } 414.$$

271×414 in denary, scale $= 112194$

$$\begin{array}{r} 1\ell7 \\ 2\ell6 \\ \hline e36 \\ 169\ell \\ 392 \\ \hline \end{array}$$

$$\begin{array}{r|l} 10 & 54e16 \\ \hline 10 & 65\ell e\ 4 \\ 10 & 795\ \ 9 \\ 10 & 91\ \ 1 \\ \hline & e\ \ 2 \end{array} \qquad \text{Ans. } 112194.$$

6. CHARLES MORGAN, Cardiff.—The diameter of a circle inscribed in a right-angled triangle is equal to the excess of the base, and perpendicular above the hypotenuse.

You do not say by what method you wish this to be done, so we choose our own.

If a, b, c be sides of right-angled triangle—s the semi-perimeter, Δ the area, r the radius—

$$2r = \frac{2\Delta}{s} = \frac{2ab}{a+b+c} = \frac{a^2+b^2+2ab-c^2}{a+b+c} \text{ for } c^2 = a^2+b^2$$
$$= \frac{(a+b)^2-c^2}{a+b+c} = (a+b-c)$$
$$= a+b-c$$

7. T. GRINDLE, Salford.—Unfortunately, to answer your question would involve a criticism upon an article which has appeared in the PRACTICAL TEACHER. This is a thing we most studiously avoid.

8. EPSILON, Leamington.—We cannot help you. There are some 300,000 medical terms, and we must with sorrow confess that we are not conversant with them all. We can suggest one solution, however, that as the phrase occurred in a daily paper's scientific leading article, if it were analysed it would be found to have no meaning at all. This is usually the case. Of course the general sense of the passage you quote is clear. Vaccine is originally taken from cows during cow-pox. After a human being has been inoculated with this fresh vaccine, the lymph which occurs in the consequent eruptions is found to have all the properties of fresh vaccine, but not in so great strength. The meaning then is that after the lymph has been passed through several bodies it is no longer a certain preventive of smallpox; in fact, it is in great measure now useless.

9. JE NE SAIS PAS, LEES.—We have previously in the *Q. C.* recommended M. Chardenal's books for your wants.

10. PUZZLED, Doncaster.—Solve the equations—

$$\alpha.\ \frac{1}{y+\sqrt{2-y^2}} + \frac{1}{y-\sqrt{2-y^2}} = \frac{y}{3}$$

$$\beta.\ y^2+y+1 = \frac{42}{y^2+y}$$

α. We have

$$\frac{2y}{\{y+\sqrt{2-y^2}\}\{y-\sqrt{2-y^2}\}} = \frac{y}{3}$$

$$\text{or } \frac{2y}{y^2-(2-y^2)} = \frac{y}{3}$$

$\therefore$ $y=0$ is one root and the others are given by

$$2y^2-2 = 6 \text{ or } y = \pm 2$$

β. Let $y^2+y = x$, then

$$x(x+1) = 42$$
$$x^2+x-42 = 0$$
$$(x+7)(x-6) = 0$$

$y^2+y+7 = 0 \quad y = \dfrac{-1\pm\sqrt{-27}}{2}$

$y^2+y-6 = 0 \quad y = -3 \text{ or } 2$

11. B. G., Gosport.—You would save us a good deal of trouble if, instead of sending us your lines to analyse, you would just point out where your difficulties are. We confess we fail to see them. Analyses of sentences take up so much room in proportion to their value, and we rarely attempt such in the *Q. C.* Our objection is that the subject is, as a rule, very easy, and just where the difficulties come in, every authority you can meet with has a different opinion. Mention some of your difficulties to us next number.

12. SPHINX, Cornwall.—You treat us in a remarkable fashion. Suppose, for the nonce, that we change places. You be Query Editor, we 'yours faithfully.' How would you feel if we sent you Todhunter's larger *Algebra*, with the remark that there were a good many examples in it that we had been fairly floored by, and the polite request, would the Query Editor be so kind as to work the book through, say five a month, and 'keep this communication, as it will save me the trouble of writing every month?'

You must write every time if you want an answer.

The image of an object is distant 8 inches from a convex lens of focal length 12 inches, find the distance of the object.

$$\text{Formula is } \frac{1}{D} - \frac{1}{d} = \frac{1}{f}$$
$$\text{or } \frac{1}{8} - \frac{1}{d} = \frac{1}{12}$$
$$\text{or } \frac{1}{d} = \frac{1}{8} - \frac{1}{12}$$
$$= \frac{1}{24}$$
$$\therefore d = 24$$

13. DOUBLE GLOSTER, Cam.—

(α) In what time will £400 amount to £467 18s. 10·42d. at 4 per cent. comp. int.?

(β) At what rate per cent. will 70 guineas amount to £114 16s. 10½d. in 2 years at comp. int.?

There is strictly no arithmetical method of doing a sum like this. As a guide to the course we shall pursue, take £a at r per cent. for n years. For 1 year we multiply by r and divide by 100;

$$\therefore \text{Interest for 1 year} = \frac{ar}{100}$$

$$\therefore \text{Amount after 1 ,, } = a + \frac{ar}{100} = a\left(1+\frac{r}{100}\right)$$
$$= \text{Original amount} \times \left(1+\frac{r}{100}\right)$$

$\therefore$ Amount after second year

$$= \text{first amount} \times \left(1+\frac{r}{100}\right)$$
$$= \text{original} \times \left(1+\frac{r}{100}\right)^2$$

etc.

Hence after n years, if M be the amount,

$$M = a\left(1+\frac{r}{100}\right)^n$$

If M and a be given, also r and n be required, taking logarithms

$$n \log\left(1+\frac{r}{100}\right) = \log M - \log a$$
$$\therefore n = \frac{\log M - \log a}{\log(100+r) - 2}$$

If, however, n be given, and r be required, we can always do it by Arithmetic, for

$$1+\frac{r}{100} = \left(\frac{M}{a}\right)^{\frac{1}{n}} \text{ and this can always be found.}$$

Thus in your second sum

$$n=2 \quad M=£114\ 16s.\ 10\tfrac{1}{2}d.$$
$$a=£73\ 10s.\ 0d.$$
$$\frac{M}{a}=\frac{114\cdot84375}{73\cdot5}=1\cdot5625$$
$$\therefore 1+\frac{r}{100}=\sqrt[2]{1\cdot5625}=1\cdot25$$
$$\therefore r=25$$

In the first example we have two choices open, either to find an approximate result by trial, which is a very pitiable process, though it would necessarily be successful if n were integral, or to take logarithms. Adopting the latter course

$$M=£467\ 18s.\ 10\cdot42d.$$
$$=£467\cdot943417 \text{ (nearly.)}$$
$$a=£400, \quad 100+r=104$$

Hence
$$\frac{\log M-\log a}{\log (100+r)-2}$$
$$=\frac{2\cdot6701935-2\cdot6020600}{0170333393}$$
$$=\frac{\cdot0681335}{\cdot0170333393}$$

17·0333393) 68·1335000 (4·000008
68 1313572
1428000000

Ans. 4·000008 % or 4%.

There are one or two noticeable points about a sum of this sort. In the first place, our answer is inexact by *eight millionths* per cent. It is the very rare exception for the method of logarithms to bring answers quite exact. Also in finding the value of π we took numerator logarithms to 7 places, denominator to 10. This last is a general principle founded on obvious rules. It is worth noticing for its own sake.

14. J. R. B., Leominster.—A grocer bought two lots of tea; for one lot he gave 6s. per lb.; and for the other 4s. per lb. In what proportions must he mix them so as to be able to sell the mixture for 5s. 3d. per lb., and gain 20 per cent. on outlay.

Selling price 5s. 3d. gain 20%
∴ Selling value is $\frac{5}{6}$ × 5s. 3d. = 4s. 4½d.
Thus 8 lbs. of mixture are worth 35s.
Hence 6 × No. of lbs. of first quality
+ 4 × No. of second quality = 35s.
for first quality costs 6s. per lb.
Also No. of lbs. of 1st + No. of 2nd = 8
∴ 6 × No. of lbs of 1st + 6 × No. of 2nd = 48
∴ 2 × No. of 2nd = 13
∴ there are 6½ lbs. of 2nd quality
and 1½ lbs. of 1st quality.

15. F. S., Romford.—If n be a whole number, what is the least value of n for which $(\frac{1}{3})^n < \frac{1}{8}$.

The only arithmetical way is to take n equal to all the integers in succession

$n=1$	$(\frac{1}{3})^n \times 8$	$\frac{1}{3}$
$n=2$		$\frac{1}{9}$
$n=3$		$\frac{1}{27}$
$n=4$		$\frac{1}{81}$
$n=5$		$\frac{1}{243}$
$n=6$		$\frac{1}{729}$ and this is less than one.

Of course, to get these fractions multiply the numerator of each by 2, and the denominator by 3. If n were not an integer this course would fail. In this case we must use logarithms: let us find the values of n for which $(\frac{1}{3})^n = \frac{1}{8}$

$$n\{\log 2-\log 3\}=-\log 8$$
$$\therefore n=\frac{\log 8}{\log 1\cdot5}$$
$$\frac{\cdot9030900}{\cdot1760913}$$

To find this expeditiously take logarithms again.

$$\therefore \log n=\log 90309-\log (17609\cdot13)$$
$$=\cdot9557310-\cdot2457373$$
$$=\cdot7099937$$
$$n=5\cdot1285375$$

This answer will be correct probably to the last decimal place. All values of n greater than this will make

$$(\tfrac{1}{3})^n<\tfrac{1}{8}.$$

16. A. L., Kensington.—If the equations $x\cos\alpha+y\sin\alpha=p$ $\frac{x}{a}+\frac{y}{b}=1$ $Ax+By=C$ $y=mx+c$ represent the same line then

$$p=\frac{C}{(A^2+B^2)^{\frac{1}{2}}}=\frac{ab}{(a^2+b^2)^{\frac{1}{2}}}=\frac{c}{(1+m^2)^{\frac{1}{2}}}$$

p is the perpendicular from the origin on the line. Now by the ordinary formula, the perpendicular from (x, y) on the lines is

$$=\pm\frac{\frac{x}{a}+\frac{y}{b}-1}{\sqrt{\frac{1}{a^2}+\frac{1}{b^2}}}=\pm\frac{Ax+By-C}{\sqrt{A^2+B^2}}$$

$$=\pm\frac{y-mx-c}{\sqrt{1+m^2}}$$

Hence p the perpendicular from origin

$$=\frac{1}{\sqrt{\frac{1}{a^2}+\frac{1}{b^2}}}=\frac{C}{\sqrt{A^2+B^2}}=\frac{c}{\sqrt{1+m^2}}$$

$$=\frac{ab}{\sqrt{A^2+b^2}}$$

the sign given to the radical being such as in all cases to make the perpendicular pos tive.

17. FEMINA, Bradley.—We believe marks are given for each branch of drawing. No list such as you want is published.

18.—ANGUIS, Bradley.—We recommend the following text-books for the Q. S. Examination:—*Arithmetic*, Mansford's (4s. 6d.); *History*, Curtis (large vol.); *Algebra*, Todhunter (7s. 6d.); *Mensuration*, Elliott's (2s.); *School Management*, Currie's (Stewart); *Music*, Sutton's.

12. PERMUTATION.—If you take the trouble to read our rules we shall be happy to oblige you with your problem next time.

20.—TOM, Horsham.—Try Abbott's two books on 'How to tell the Parts of Speech,' and 'How to Parse.'

21.—ENQUIRER, Cefn.—They appear in our present issue.

22.—L'ALLEGRO, Hasland.—A farm is let for £96 and the value of a certain number of quarters of wheat. When wheat is 38s. per quarter the whole rent is 15 per cent. lower than when it is 56s. a quarter. Find the number of quarters of wheat which are paid as part of the rent.

Let x be the number of quarters.
Then when wheat is 38s. whole rent is

$$£\left(96+\frac{38}{20}x\right)=£\left(96+\frac{19x}{10}\right)$$

When it is 56s. it is £96 + £$\frac{14}{5}x$.

$$\therefore 96+\frac{19x}{10}=\frac{85}{100}\left(96+\frac{14}{5}x\right)$$

$$\text{or } \frac{96\times15}{100}=x\left(\frac{17}{100}\times\frac{14}{5}-\frac{19}{10}\right)$$

$$=x\left(\frac{238-100}{100}\right)$$

$$=x\tfrac{138}{100}$$

$$\therefore x=2\times15=30.$$

It will not be hard for you to translate this into arithmetical language if you require it so.

23. GIVALIA, Pen-y-Cwm.—In a cricket match the scores in each successive innings are ½ less than in the preceding innings; and the side which has the first innings wins by 50 runs. What are the scores in each innings?

Let us suppose the first score to be 320, the second is $\frac{3}{4}$ of 320, or 240; the third is $\frac{3}{4}$ of 240, or 180; the fourth is $\frac{3}{4}$ of 180, or 135.

$\therefore$ the first side scores altogether

$$320+180 = 500$$

and the second

$$240+135 = 375$$

$\therefore$ the first wins by 125.

But it actually wins by 50.

Hence

$$\text{first score} : 320 :: 50 : 125$$

$$\therefore \text{first score} = \frac{320 \times 50}{125} = 128.$$

24. H. G., Richmond.—One square is inscribed in another in such a position that the areas of the two are in the ratio of 16 to 25, the side of the larger square being 10. What is the distance of each corner of the inner square from each extremity of that side of the outer square on which it rests?

The areas are as 16 : 25.
$\therefore$ the sides are as 4 : 5.
$\therefore$ the sides are 8 and 10.

Let ABCD be the larger square,
and PQRS " smaller "
P being between A and B.

Let AP = x, and AB = 10.

It can be easily proved by Elementary Geometry that

$$AP = BQ = CR = DS = x,$$
$$\text{and } PB = QC = RD = SA$$
$$= 10 - x.$$

But $PS^2 = SA^2 + AP^2$ (Euclid I., 47).

But PS = 8

$$\therefore 8^2 = (10 - x)^2 + x^2$$
$$= 2x^2 - 20x + 100$$
$$\therefore x^2 - 10x + 18 = 0$$
$$x^2 - 10x + 25 = 7$$
$$x^2 = 5 \pm \sqrt{7}.$$

25. NORTH, Penrith.—If the sides of any triangle be bisected, prove that the lines drawn at right angles to the sides through the points of bisection meet in a point.

Let ABC be the triangle, E and D the middle points of AB and BC respectively, EO and DO perpendiculars to the sides at these points. EO and DO meet in a point for joining ED, we have DEO + EDO less than ODB + OEB, *i.e.*, less than 2 right angles. Hence, by Axiom. EO and DO intersect.

From O draw OF perpendicular to AC, we shall prove that F is the middle point of AC.

We have BD = DC, OD common, and angles ODB, ODC each equal to a right angle.

$\therefore$ by Euclid I., 4, OB = OC.

Similarly OB = OA.

Hence OA = OC,
But $OA^2 = OF^2 + FA^2$,
and $OC^2 = OF^2 + FC^2$, by Euclid I. 47.
$\therefore FA^2 = FC^2$.

26. SCHOOLMISTRESS, Hallsworth.—Eight bells begin tolling simultaneously, and they toll at intervals of 1, 2, 3, 4, 5, 6, 7, 8 seconds respectively; find after what interval of time they will again be all tolling at the same instant.

The rule in all such sums is to take the L.C.M. after reducing all the intervals to the same denomination. In this case no reduction is needed, and L.C.M. is $8 \times 7 \times 5 \times 3$, or 840 seconds, or 14 minutes. The reason of this will be seen at once by an example. Suppose the intervals were 3, 5, 6, the following table represents the tollings of each bell, the bells being represented by Roman numerals. The figures refer to the number of seconds after the commencement when the tollings took place, and a star indicates that a bell tolled in that second under which it is placed:—

	1	2	3	4	5	6	7	8	9	10	11
I.	*			*			*			*	
II.	*					*					*
III.	*						*				

	12	13	14	15	16	17	18	19	20	21	22
I.		*			*			*			*
II.					*					*	
III.		*						*			

	23	24	25	26	27	28	29	30	31
I.			*			*			*
II.				*					*
III.			*						*

Thus, the only rows in which there are three asterisks are 1 and 31, and there is between these an interval of 30, or 6×5, which is the L.C.M. of 3, 5, and 6.

The diagram would be very useful in explaining the same to children.

27. LIBRA, Lincoln.—The *Proceedings of the Royal Astronomical Society* is the only strictly astronomical publication we know of. It is very technical.

Nature, published monthly (6d., Macmillan), would probably suit you as well. Or try *The English Mechanic and World of Science* (weekly, 2d.).

28. NEMO, Escomb.—A lb. of tea and 3 lbs of sugar cost 6s.; but if sugar were to rise 50 per cent. and tea 10% they would cost 7s. Required price of tea and sugar.

The conditions are equivalent to

1 lb. tea + 3 lbs. sugar = 6 shillings
$\frac{11}{10}$ lb. tea + $\frac{3}{2} \times 3$ lbs. sugar = 7 shillings
1 lb. tea + $\frac{11}{2}$ lbs. sugar = $\frac{11}{10}$ shillings
$\therefore$ $(\frac{11}{2} - 3)$ lbs. sugar = $\frac{11}{10} - 6$
or $\frac{5}{2}$ lbs. sugar = $\frac{49}{10}$ shillings
Sugar = 4d. and tea = 5s.

29. Y. P., Otley.—We do not know any separate edition. If there is one published there will not be more than one, and your bookseller will be able to get it for you. You will probably not obtain one with a vocabulary.

30. PUZZLED, Barnstaple.—If, as you say, you have done neither Latin nor French, we think it is folly of you to try and take them next July. Your time would be almost wasted. If you are determined, French is the easier, but you will almost certainly fail if you try to learn it altogether by yourself.

31. THETA, Market Drayton.—You should learn all Morris, but may omit the greater part of Anglo-Saxon lists at the end. You should however be thoroughly familiar with the main principles of A. S. Grammar.

Morris' and Skeat is one book.

32. S. M. S., Alfreton.—If 4 men with 7 women earn £5 9s. 0d. in a week, and 5 men with 2 women earn £4 9s. 0d. in the same time, in what time will 3 men and 3 women earn £6 6s. 0d.?

(The answer you quote is absurd).

4 men + 7 women earn 109 shillings
while 5 men + 2 women earn 89 "
Hence 8 men + 14 women earn 218 sh. per week
35 men + 14 women earn 623 sh. " "
$\therefore$ 27 men earn 405 sh. " "
$\therefore$ 1 man earns 15 sh. " "
Hence 1 woman earns 7 sh. " "
$\therefore$ 3 men + 3 women earn 66 sh. in a week
$\therefore$ they will earn 126 sh. in $\frac{126}{66}$ weeks or $1\frac{10}{11}$ weeks.

33. J. SAUNDERS, Bourton-on-the-Water.—We confess we do not see what you wish explaining. The general sense is surely clear.

34. A WELSH, P.T., Carnarvon.—We cannot suggest any improvement in your method. Surely you can draw lines with fair exactitude without a ruler, so that its prohibition cannot affect you much.

35. YELSERP, Southampton.—A company consists of 1 captain, 2 lieutenants, 6 sergeants, 10 corporals, 50 men, who storm a fort, finding a prize worth £1600, which is divided among

them according to their pay and time of service. The captain has been in service for 15 years, and is paid 11s. 7d. a day; the lieutenants have served $3\frac{1}{2}$ years, and are paid 6s. 6d. a day; the sergeants have served 7 years, and are paid 2s. 6d. a day; the corporals 4 years, and are paid 1s. 6d. a day; and the men 2 years, and are paid 1s. a day. What portion of the prize did each receive?

It will be seen at once, on reducing the payments to pence, that

Captain's share : that of the two lieutenants : that of the 6 sergeants : that of the 10 corporals : that of the 50 men
$\therefore$ $139\times15 : 2\times78\times\frac{7}{2} : 6\times30\times7 : 10\times18\times4 : 50\times12\times2$
i.e. :: 695 : 182 : 420 : 240 : 400. Hence the captain receives $\frac{695}{695+182+420+240+400}$ of spoil or $\frac{695}{1937}$.

Each lieutenant ... ... $\frac{1}{2}\times\frac{182}{1937}$ or $\frac{91}{1937}$
Each sergeant ... ... $\frac{1}{6}\times\frac{420}{1937}$ or $\frac{70}{1937}$
Each corporal ... ... $\frac{1}{10}\times\frac{240}{1937}$ or $\frac{24}{1937}$
Each man... ... ... $\frac{1}{50}\times\frac{400}{1937}$ or $\frac{8}{1937}$

These fractions multiplied by 1600 will give the answers in pounds; thus, if the spoil had been £1937, the division would have been £695, £91, £70, £24, £8.

He who likes tedious work can simplify these. The sum is ineffably dreary, besides being involved in an ambiguity which may bring it to pass that all our precious work is wrong.

36. ENQUIRER, Portsmouth.—100 acres are planted with barley one year and 75 the next year. Each year $\frac{1}{4}$ of the produce is of the best quality and $\frac{2}{3}$ of the remainder of medium quality, which sells at $\frac{3}{4}$ of the price of the best. The rest is inferior, and sells for $\frac{3}{4}$ of the price of the medium quality. The second year the yield per acre is $\frac{1}{4}$ as much again as before; and, the malt-tax having been abolished, the prize of the best barley falls 9s. 4d. per quarter; while that of the medium quality only falls 2s., and the inferior is unaltered in price. If the whole of the barley sells each year for the same total sum, find the prices of the different qualities.

In the second year the yield is $\frac{1}{4}$ as much again as before. Hence there is an equivalent to $\frac{1}{3}$ of 75 acres or $\frac{225}{3}$.

Hence first year we have the yield of 25 acres best quality—
$\frac{225}{3}$ acres medium, @ $\frac{3}{4}$ price of best.
$\frac{75}{4}$ " inferior, @ $\frac{3}{4}$ "

The second year we have—
$\frac{225}{3}$ best quality, @ former price — 9s. 4d.
$\frac{225}{3}\cdot\frac{3}{4}$ medium, @ $\frac{3}{4}$ best price — 2s.
$\frac{225}{3}\cdot\frac{3}{4}\cdot\frac{3}{4}$ inferior, @ $\frac{3}{4}$ best price,

Hence equating the gain through increase of quantity to the loss through the decrease of price.
$\frac{225}{3}\cdot\frac{1}{4}\cdot25+(\frac{225}{3}\cdot\frac{2}{3}\cdot\frac{1}{4})\frac{3}{4}+(\frac{225}{3}\cdot\frac{1}{4}\cdot\frac{3}{4})\frac{3}{4}$ bushels
at the price of the best quality are equivalent to
$9\frac{1}{2}\times\frac{225}{3}\cdot\frac{1}{4}+\frac{225}{3}\cdot\frac{1}{3}\cdot\frac{1}{4}\times2$ shillings,

or $\frac{25}{3}+\frac{x}{3}\cdot\frac{225}{16}+\frac{x}{4}\cdot\frac{75}{8}$ bushels.
$=\frac{25}{3}\times\frac{225}{16}+\frac{225}{16}\frac{x}{3}$ shillings,
or $\frac{1}{3}+\frac{x}{16}+\frac{x}{17}$ bushe's $=\frac{21}{2}+\frac{33}{16}\frac{x}{17}$ shillings,
or $\frac{6+9+2}{48}$ bushels $=\frac{168+81}{16}$
or $1\frac{7}{48}$ bushels $=\frac{249}{16}$ shillings.
$\therefore$ therefore 1 bush. cost $\frac{747}{17}$ shillings.
or 44 shillings nearly.
or £2 4s. nearly.

Hence the three qualities are at—
44s. per qr.
29s. 4d. per qr.
19s. 6d. per qr.
} approximately.

37. EPILSON.—It is not your statement of the problem that is wrong; the original is so beautifully vague as to make half a dozen meanings possible. If it will do you any good to work it out under several different meanings, we are willing, but do not expect to get your answer. Cannot you see this? We are very sorry we are unable to help you.

38. G. LAMOTTE, Teynham.—Solve the equations,

$$x^2=\frac{39}{y}-\frac{14}{x}$$
$$y^2=\frac{42}{x}-\frac{13}{y}$$

As algebraical symbols are nearly always easier to deal with in complicated equations than numerical quantities, write the equations,

$$\left.\begin{aligned}x^3&=\frac{a}{x}+\frac{b}{y}\\ y^3&=\frac{c}{x}+\frac{d}{y}\end{aligned}\right\}$$
Or $x^3y=ay+bx$
$y^3x=cy+dx$
Hence $y=\frac{bx}{x^3-a}$ and substituting this value in the second,
$b^2x^4=bcx(x^3-a)^2+dx(x^3-a)^3$
Or $b^2x^3=bc(x^3-a)^3+d(x^3-a)^3$
Put $x^3=X$
$b^2X=bc(X-a)^3+d(X-a)^3$
$\therefore dX^3+X^2(bc-3ad)+X(3a^2d-2abc-b^2)+a^2bc-a^3d=0$
Hence putting
$$3A_1=\frac{bc-3ad}{d}$$
$$3A_2=\frac{3a^2d-2abc-b^2}{d}$$
$$A_3=\frac{a^2bc-a^3d}{d}$$
We have
$X^3+3A_1X^2+3A_2X+A_3=0$
Put $X=Y-A_1$ and let
$3B_2=3A_1^2-6A_1^2+3A_2=3(A_2-A_1^2)$
$B_3=-A_1^3+3A_1^3-3A_1A_2+A_3=2A_1^3-3A_1A_2+A_3$
and the equation becomes
$Y^3+3B_2Y+B_3=0$
Put $Y=w+z$ and $wz=-B_2$
and we get
$w^3+z^3+B_3=0$
or $w^3-\frac{B_2^3}{w^3}+B_3=0$
$w^6+B_3w^3-B_2^3=0$
$$\text{or } w=\omega\left\{\frac{-B_3\pm\sqrt{B_3^2+4B_2^3}}{2}\right\}^{\frac{1}{3}}=\omega\rho\text{ (say)}$$
where ω is a cube root of unity.
Hence finally
$$x=\omega\left\{\omega\rho-\frac{B_2}{\omega\rho}-A_1\right\}^{\frac{1}{3}}$$
and therefore has nine values, since ω is capable of either one of the three values 1, $\frac{-1\pm\sqrt{-3}}{2}$

The values of the terms B_2, etc., must be calculated in order to get X numerically.

Thus the general case is completely solved. Using the numerical values we can easily find position of roots.

It is scarcely worth while, however, to work it out in full. We will merely indicate the familiar method in Theory of Equations. Let $f(x)$ be the equation. Write down the series of signs of the expressions

$f(-\infty)\ldots\ldots f(-10)\,f(-9)\ldots\ldots f(-1)\,f(0)\,f(1)\ldots\ldots f(7)\,f(8)\ldots\ldots f(+\infty)$.

If any of these, say $f(a)$ vanishes, a is a root. If not, observe where the signs change. Thus, if $f(a)$ and $f(a+1)$ are of opposite signs, a root lies between a and $a+1$.

39. T. O. MUMMERY, Folkestone.—If from the extremities of any chord in a circle lines be drawn to any point in the diameter to which it is parallel, the sum of their squares is equal to the sum of the squares of the segments of the diameter.

Let AEB be the diameter, E being the centre; CFD be the chord, F being its middle point, C and A being on the same side of FE, K the point in the diameter AB being taken between A and E.

Then by an ordinary theorem (Todhunter's Euclid, Appendix i.),
$CK^2+KD^2=2KF^2+2CF^2$
$=2KE^2+2EF^2+2CF^2$
$=2KE^2+2AE^2$
$=AK^2+KB^2$. (Euc. II. 9.)

40. W. R., Shetland.—In the base of a triangle to find a point from which if two lines be drawn (1) perpendicular (2) parallel to the two sides of the triangle their sum shall be equal to a given line.

Let ABC be the given triangle, base AC.

(1) Let O be the point required, and OM, ON the perpendiculars from O on the sides AB, BC respectively.

Then the sum of the rectangles AB.OM + BA.ON is equal to the rectangle contained by AB and the given line.

But the rectangles AB OM + BC ON equal twice the sum of areas of AOB and COB, *i. e.*, to twice the area of ABC.

∴ the difference of the rectangles ON.BC and ON.BA is equal to the difference between the rectangle contained by AB and the given line, and twice the area of ABC.

Now, by Euclid I. 45, make a rectangle equal to the area which represents the difference between these two, one of whose sides is the difference between BC and AB, then the other side is ON, and thus ON is known.

From the point C draw CD perpendicular to BC, D and A being on the same side as BC, and through D draw DO parallel to BC. DO will meet AC in O, the point required.

(2.) Suppose O the required point, PQ the given line; OM, ON the lines through O parallel to BC, AB respectively.

Then OM : AO = BC : AC (Euc. VI. 4),

or rectangle OM.AC = rect. AO.BO.

Also ON : OC = AB : AC

= rect. AB.AC − rect. AB.AO.

Or rect. ON.AC = rect. OC.AB

∴ by addition

Rect. contained by AC and P Q

= rect. AB.AC + rect. contained by AO and diff. of BC and AB.

$$\text{or } PQ = AB + \frac{AO}{AC}(BC - AB)$$

$$\therefore AO = \frac{AC}{BC - AB}(PQ - AB.)$$

Wherefore take a fourth proportional AO to the three lines BC − AB, AC, and the difference between the given line and AB.

The distance AO being taken from A along AC, gives O the required point.

41. X. Y. Z., Mossley.—Draw a line DE parallel to the base BC of a triangle ABC, so that DE is equal to the difference of BD and CE.

Draw BF bisecting the angle ABC and CF bisecting the angle ACK, K being in BC produced. Let these meet in F, and draw FED parallel to BC, then FED is the line required.

For DBF = CBF = BFD

∴ BD = DF

Similarly CE = EF

∴ BD = DE + EC

∴ BD − EC = DE.

42 and 43.—QUERIES UNANSWERED.—The Query Editor has this month been unavoidably compelled to answer the whole of the queries at short notice, so that it will be quite excusable if the previous work is at all faulty. In consequence of this haste he has not been able to give to the two following problems the attention they require. He considers that they are worthy of the attention of the readers, as admitting of a variety of solutions, and accordingly offers them for general competition, and will be glad to insert a notice of any successful attempts:—

N. E. SANDERSON, Sheffield.—Given the four sides of a quadrilateral figure in order, and the angle between one pair of opposite sides, construct the figure. (*Science and Art*, 1881.)

A SUBSCRIBER, Nottingham.—ABC is any triangle. AD bisects the angle A, and AE is drawn to E, the middle point of BC; prove that AE > AD. (By Euclid I. 19, or previous propositions.)

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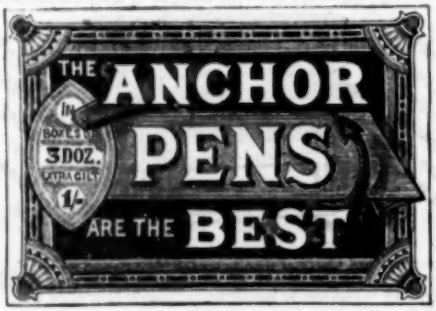

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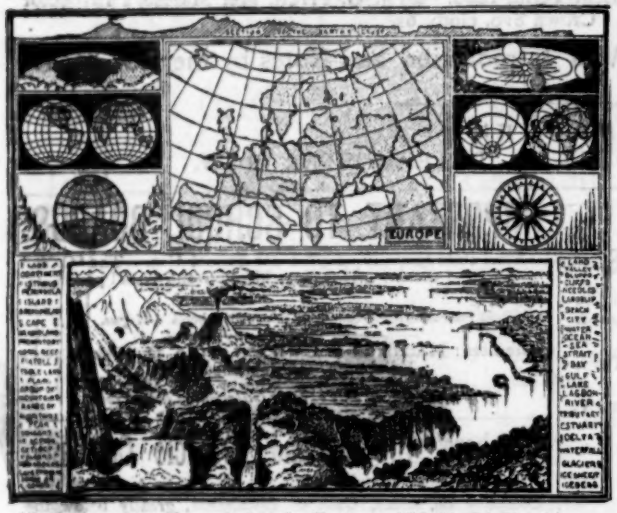

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